

# ANNALS OF SURGERY

A MONTHLY REVIEW OF SURGICAL SCIENCE AND PRACTICE

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# ANNALS *of* SURGERY

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## THE CANCER PROBLEM

By C. MANSELL MOULLIN, F.R.C.S.

OF LONDON

THE cancer problem is with us still. No solution has been found as yet. It is not even known from what direction the solution, for there must be one, will come. Much time and money have been spent in research work. A few new facts have been recorded. Many old ones have been restated in other terms. But so far the frontal attack has failed. Is it possible to make any advance by an attempt upon the flank?

Is there such a thing as cancer? Does cancer really exist as a definite entity, a thing by itself? The cancer of every organ in the body is different from the cancer of every other organ. The appearance is different and the clinical significance is different. Every structure in the body has its own particular kind. The cancer of each individual is as different from the cancer of all other individuals as his constitution is from theirs. Two cases may appear to be exactly alike, but it is impossible from a knowledge of one to predict, with any degree of certainty, what will be the course of the other. Can it be said that there is such a thing as cancer existing by itself? Or is it not, like all other tumors, in reality a form of growth, or rather of growing?

It certainly cannot be separated from other tumors. No definite line can be drawn between cancer and sarcoma on the one hand, nor between cancer and certain varieties of undoubtedly innocent tumors on the other. For convenience of classification innocent tumors are collected into one group and malignant ones into another, but between the two there is a borderland of which no one can say to which side the growths belong nor even whether they do not belong at one time to one side and at another to the other. It is certain that many innocent tumors end by becoming malignant. And what are called malignant tumors differ among themselves no less in the degree of their malignancy. There are no hard and fast lines of division anywhere. It is a mistake to try and form a conception of cancer as something apart from all other tumors. It is one of them, and not to be separated from



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them. The clinical features so often regarded as distinctive, such as the power of dissemination, are in no way peculiar to it. They are merely an exaggeration of powers that can be exercised by many embryonic cells.

The starting point of all tumors, cancerous or not, is a bud growing out from cells which appear to be normal. Until that moment the development of these cells seems to be following the ordinary lines. There is no apparent difference between them and those that preceded them or those that lie around. Suddenly their development stops. Whatever the point it has reached, it does not advance one step farther. But their growth continues, with all the more vigor because now no energy is being consumed in raising the cells to a higher plane. Their increase is controlled by nothing but the supply of food and the pressure of the structures around. The result is a shapeless, formless mass of cells, resembling their parent in a general way, never advancing to a higher plane of development, never doing any work, but growing without ceasing—in other words, a tumor.

The kind of tumor depends partly upon the kind of cell, partly upon the stage in development it had reached at the moment progress was arrested. If the cell has already attained a high degree of specialization, the tumor cells are highly specialized too. Their rate of increase is slow. Surrounding structures are pushed to one side without being invaded; and the tumor is called innocent. If, on the other hand, the arrest of development takes place while the parent cell is still in the embryonic period of life, with all the vigor of youth unimpaired, the cells retain their embryonic character, growth is rapid, and the tumor is malignant. The cells, for example, are capable of transplantation, travelling in the lymphatics or in the blood stream, along the lines of least resistance. Many of them perish in their wanderings, it is true, for now they are invaders and attacked as such; but some survive where the conditions are favorable, and these become the starting point for similar tumors.

The problem, therefore, of the origin of cancer and other tumors turns upon the relation that exists between growth and development. Growth, increase in size, and then increase in number, is a property inherent in all tissue-cells, so long as they are living. It is born in them with their birth, lives with them throughout their lives, and dies with them when they die. So long as the conditions are favorable, it knows no bounds or limits. Development is the outcome of the inheritance from ages past of all the countless variations that were acquired in

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days gone by and have been transmitted from generation to generation. It is dependent upon heredity, and it is the force that directs and controls growth. If its power fails, no matter what stage it may have reached, growth at once asserts itself with all the energy it has left, and the cells increase and multiply until they form a tumor.

Failure of this power may be due to many causes. Age is one. As years advance the energy that lies behind development becomes feebler, and tumors of all kinds become more numerous. In infancy and childhood they are comparatively rare. In adult life they become more common. In old age they may be present in hundreds. This is no less true of organs than it is of individuals. Some organs grow old long before others, and these are especially prone to become the seat of tumors. Disuse is another. It is notorious that organs which, from not being used as they should be, fail to attain the full perfection of development, are peculiarly liable to cancer. Injuries, especially those which by constant repetition interfere with the building up of the tissues, are often followed by tumors. A single blow is sufficient if the structure affected is in a state of active development. Scars, particularly those which are poorly developed, because they have remained unhealed for some considerable time, or have broken down again after having healed, are peculiarly liable to become the seat of cancer. Organs that for other reasons remain immature and fail to develop are far more subject to malignant disease than those which attain their full proportions at the proper season. Everywhere that there is increased liability to the formation of tumors and of cancer, there is either weakening or actual arrest of the force that lies behind development.

There is the same increased liability if, while development continues at or near its normal level, growth is unduly stimulated so as to upset the balance between them. Tumors of various kinds are nearly always present in organs that have become overgrown from other than physiological causes, and also in those cases in which limbs or other portions of the body have attained disproportionate dimensions owing to something that has happened in early embryonic life.

The increased liability to the formation of tumors is no less marked if the course of development is checked by artificial means. Certain forms of cancer as well as other tumors can be produced almost at will by means of chemical or physical agents which impair the development of the tissues and prevent them from attaining full structural perfection. One of the best examples is the skin, for here the changes can be seen. The late Sir J. Hutchinson long since pointed out that the prolonged

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internal administration of arsenic was liable to affect the nutrition and the structure of the skin, causing it to become harsh and dry, and that a form of cancer not uncommonly followed. The action of soot in causing cancer is well known, but it is often overlooked that there is a long preliminary stage in which the skin becomes cracked and dry, and covered over with warts. Tar has a somewhat similar effect, only the form of growth is not quite the same. The influence of repeated exposure to the Röntgen rays upon the skin—the alteration in its texture, the production of warts, and then of cancer—is only too well known. And the great frequency of rodent ulcer in certain parts of Australia has been attributed, probably correctly, to the atmospheric conditions that prevail there, and the effect they have upon the tissue changes in the skin. But it is not confined to the skin. Similar examples occur in connection with other organs. Workers in aniline colors, for instance, are peculiarly prone to the occurrence of tumors (including cancer) in the excretory organs; and those who are employed in cobalt mines to similar growths in the lungs; only because of the situation of these organs we have no evidence of preliminary structural changes in the tissues.

These effects are produced by foreign agents, introduced or acting from without. Whether similar effects can be produced by substances that are manufactured in the body itself is not known. We have too little knowledge as yet of the intimate chemical changes that take place in the tissues to form any opinion.

The supposed inheritance of certain kinds of tumors and of cancer is only to be explained in this way. Tumors, like other acquired features, are not inherited, yet there is no doubt that some families are much more prone to the formation of tumors and of particular kinds of tumor, or at particular times of life, than others. The power of hereditary transmission, upon which development depends, varies in strength in different families. In some special features are handed down unchanged from generation to generation, while in others they can scarcely be traced. So it is with the tissues. In some the power of heredity is so strong that the tissues maintain throughout life the full perfection of their development, and growth is never allowed undue license. In others the power is weaker, and liable to fail. Then if, because of some injury or irritation, there is a great production of young, rapidly-growing cells, development is checked, and growth at once becomes rampant. It is not the tumors that are inherited, but the strength of the force that compels development and so controls growth. This may fail in several members of the same family for generation after generation, just as the



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transmission of special features may fail, and lead to those members suffering from the same form of tumor at perhaps the same time of life.

There are two factors, therefore, working together in the production of cancer and other tumors. One is arrest, or weakening, of the power of development, due to failure in heredity, age, disuse, injury, the interference of chemical or physical agents, or other causes. The other is local irritation leading to increased cell-growth. The effect of their combined action is the production of masses of cells which never attain their perfect form and which increase with a rapidity that depends upon the stage at which their development was stopped, and upon the supply of food.

Cancer and other tumors will never disappear. There is indeed reason to think that they may become more common as civilization advances. The proportion of aged people, who are the most susceptible, will continue to increase; and it is to be feared that artificial modes of living may still further weaken the hereditary force of development that guides and controls the innate power of growth. On the other hand, a clearer conception of the causes that lead to the production of cancer, a better knowledge of the chemical changes that take place in the tissues, and the avoidance of local causes of irritation may do much to produce the opposite effect.

## INFLUENCE OF INHALATION ANÆSTHESIA ON THE ACIDITY OF THE BLOOD AS DETERMINED BY ESTIMATION OF H-ION CONCENTRATION\*

BY GEORGE W. CRILE, M.D.

OF CLEVELAND, OHIO

THE energy of the body which in different ways is derived from the environment is temporarily stored in different organs and tissues until, in response to some adequate stimulus, it is transformed into heat or motion. Prominent among the products of this transformation of latent into kinetic energy are acids. We may say that every motion, every emotion, every injury, every physical exertion, every degree of fever, every reaction to infection or to auto-intoxication, every respiratory movement, every heart beat produces acid by-products. Under normal conditions these acids are neutralized—into harmless compounds which are eliminated by the kidney—so that under normal conditions the body tissues and fluids are slightly alkaline. If every activity of the body produces acidity in a greater or less degree, it is vitally necessary for the body to maintain a large margin of safety against acidosis by the presence of alkaline salts and bases, which are derived from food. Experiments have shown that for the maintenance of its normal state of alkalinity, the body is dependent mainly upon the liver, and perhaps secondarily upon the suprarenals and the thyroid. When the liver is excised the blood soon loses its slight alkalinity and in a few hours becomes acid. When the suprarenals are excised the alkalinity of the blood is maintained for a longer period—perhaps twice as long—but it then becomes acid, and in each case the acidity of the blood is the close precursor of death. The excision of no other organ in the body produces this tendency to an immediate increase in acidity. Whether the increased acidity in these instances be due to dissolution; or whether dissolution be due to acidity; or whether there be no causal relation between increased acidity and dissolution has not been definitely determined.

We cannot dwell here upon other experimental observations which show the relative activities of the liver and the suprarenals in this neutralizing process, nor the evidence that the liver and the suprarenals are directly controlled by the brain, which also controls the transformation of energy, which in turn, as we have already stated, always pro-

\*Paper read before the American Association of Anæsthetists, Atlantic City, N. J., June 22, 1914.

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duces acidity; we will merely recapitulate by saying that the harder the body is driven by any stimulus, the more rapidly will latent energy be transformed into kinetic energy. The more rapid the transformation of energy, the more rapid the production of acid. The greater the production of acid, the greater also the strain upon the power of neutralization possessed by the liver and the suprarenals, and the greater the drain upon the body's store of alkalies and bases. When the liver and the suprarenals are overtaxed and the alkalies and bases are exhausted, the state of acidosis is reached.

Clinically it has long been recognized that when a patient is in a state of exhaustion resulting from infection, from injury, from shock, from starvation, from hemorrhage—from any cause whatsoever—he may never recover consciousness after the administration of a general anæsthetic. In a foreign reference, which I cannot now recall, it is shown that dogs first starved then anæsthetized inevitably die. Clinicians know well how unsafe it is to give a general anæsthetic of any kind to a patient on the verge of acidosis. A patient with chronic vomiting, with an acetone odor of the breath, with peculiarly pink lips and dry tongue and mouth may never regain consciousness after inhalation anæsthesia. The aged not infrequently die after even short inhalation anæsthesia.

Why do not these patients recover? If the patient have the power of consciousness before the anæsthetic is administered what happens during the anæsthesia to make it impossible for the patient to regain consciousness?

We have already referred to the acid-producing power of stimuli. Shall we conclude therefore that the trauma of the operation alone may have pushed beyond the margin of safety the neutralizing powers of the body already taxed by preëxisting conditions; or is the anæsthetic itself a factor in producing the fatal result?

To answer this question Dr. Menten, in my laboratory, made for me observations on the H-ion concentration of the blood under various conditions—the H-ion concentration being an index of the acidity of the blood.

H-ion concentration tests were made after the application of many kinds of stimuli, the results of which confirmed the postulate which we have already stated,—that acidity is the result of the activation of the body by an adequate stimulus. The blood was then tested to determine the H-ion concentration in ether anæsthesia, in nitrous oxide anæsthesia, and after the administration of alcohol and of morphine. Both ether and nitrous oxide produced a marked immediate increase in the

H-ion concentration, that is, both caused an increased acidity in the blood during anæsthesia. After coming out from the anæsthetic this acidity was neutralized by the animal in about thirty minutes. This result gave us a clue to the tendency to acidosis and to death under anæsthesia in weak and emaciated patients. The increased acidity produced by the anæsthesia was sufficient to overcome the already narrow margin of safety. That acid intoxication *follows* the administration of ether and chloroform has been noted by many observers—the acidity being evidenced by the early appearance in the urine of acetone and later diacetic acid. It has also been noted, as one writer states, that the “starvation preceding and following the operation is also a factor of considerable importance.”

Our experiments have shown, however, that the increased acidity actually develops *during the anæsthesia itself*, sometimes to a fatal degree, and that a starved condition is not only of “considerable” but of *prime* importance, since it means that the acid-neutralizing power of the liver has been surely impaired—possibly lost.

Two more important clues were obtained from the result of the H-ion concentration tests after the administration of morphine and of alcohol. Alcohol caused acidity, the acidity not being so marked, however, as that produced by the anæsthetics. The H-ion concentration was not altered by morphine no matter how large the dose. *When the administration of morphine preceded the induction of anæsthesia then a smaller amount of the anæsthetic was required to produce complete anæsthesia, and the H-ion concentration test showed that the acidity was correspondingly less than in anesthetized animals which had not received the preliminary dose of morphia.* The preliminary dose of morphia not only lessened the degree of acidity produced by the anæsthetic, but it in no way interfered with the return of the blood to its normal alkalinity; on the contrary—and the following observation is of great significance—if *morphine was given after acidity had been produced by the anæsthetic, it prolonged the period of neutralization and, if given in large doses, prevented the animal from overcoming the acidosis.* That is, it would appear that morphine controls the mechanism which governs the neutralization or alkalinization of the blood.

These H-ion concentration or acidity tests of the blood have therefore given us the clue, and an invaluable clue, to the treatment of patients with mild acidosis or in whom acidosis is threatened. Since in every case the presence of diseased conditions is undoubtedly producing a mild acidosis, needlessly long anæsthesia is to be avoided, as the increased acidity produced by the anæsthetic will diminish the patient's

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vitality. The degree of acidosis seems to be proportional not only to the length but to the depth of the anæsthesia. The lightest possible anæsthesia should be maintained therefore. *With starved patients, with patients whose vitality is at a low ebb, in whom acidosis is already markedly present, the inhalation anæsthetic may be absolutely contra-indicated.* If an operation is mandatory it may be performed under local anæsthesia, or in twilight anæsthesia produced by the gentlest administration of nitrous oxide oxygen.

Although both the preoperative and the postoperative use of morphine is of great value in certain cases, in these cases of existing or threatened acidosis its use is contra-indicated, since it interferes with or prevents the neutralization of acidity in the blood, but bromides per rectum may be safely given to diminish the preoperative psychic strain. The preoperative and postoperative administration of sodium bicarbonate and glucose is of value also.

To recapitulate—the ideal treatment for the class of patients we have been considering, those handicapped by exhaustion in whom acidosis is present or is threatened, is:

1. The preoperative administration of sodium bicarbonate and glucose and of bromides per rectum.
2. Twilight anæsthesia.
3. Complete anociation by the use of local anæsthetics and gentle manipulations so that but a small amount of the anæsthetic is needed.
4. In bad risks as rapid a technic as is consistent with good work, that the period of anæsthesia may be as short as possible.
5. The avoidance of worry, fear, and injury—since these factors also produce increased acidity.



## CONTRIBUTION TO THE STUDY OF THE STRUCTURE OF ENCEPHALOCYSTOCELE

BY CARLO SAVINI, M.D.

OF NEW YORK CITY

RECENTLY I have had under my care a case of encephalocystocele, and I have made microscopical examination of the specimen. The following is a report of the case, and an explanation of the microscopical findings.

A female child, fifteen days old, of Italian parentage, was admitted to the Washington Square Hospital July 12, 1914. The mother said that the child was born with a "lump" about the size of a hen's egg on the back of the head, and that this "lump" gradually increased in size.

The child would cry every time the "lump" was in any way manipulated or even touched, and it became necessary to provide a special soft pillow upon which to rest the child's head.

On a general examination, the child was found to be perfectly normal and well developed, except for the tumor. The swelling was almost twice the size of the head itself, in shape more or less reniform, and was connected to the head posteriorly by a large pedicle attached to the occipital bone, at and around the site of the external occipital protuberance. The longitudinal circumference measured eighteen inches, the transverse twelve inches, and the oblique sixteen and one-half inches.

The portion of the skin near the pedicle was covered with hair, the appearance of the tumor was translucent, especially in the area of greater convexity. A small rounded area of the skin, about one inch in diameter, was inflamed and necrotic, the rest of the skin was reddened.

Pressure exerted over the tumor was not accompanied by any reduction of the size of the tumor, or by any evident alteration in the circulation or respiration of the child; and no impulse could be elicited in the tumor when the child cried. The diagnosis of encephalocystocele was made, and a surgical operation deemed necessary.

The skin over the head of the child and over the tumor was shaved, and a boric acid dressing was applied over night to reduce the inflammation of the skin. On the following morning (July 13, 1914), at eight o'clock, the child was operated upon.

The skin was painted with tincture of iodine, and a trochar

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inserted into the tumor to evacuate its contents. The fluid removed measured 1000 c.c., and was serosanguinous in character. Two large clamps covered with rubber tubing were now loosely applied to the pedicle of the tumor, so as to avoid any unnecessary or great loss of blood. Two transverse skin incisions were made to insure the formation of a superior and inferior flap. The skin was dissected around the tumor, and a large sac was found in the cavity. This sac was dissected free, then opened. It was found to communicate with the cranial cavity through a small opening about one-half inch in diameter, slightly to the right and at the level of the external occipital protuberance. A strip of brainy tissue about two inches in length protruded into the sac from the opening, and was adherent to the sac walls. That portion of the brain tissue, which was nearest to the opening and easily reducible, was reduced into the cranium, and the sac, together with some brain tissue adherent, was removed. The connective tissue around the opening was sutured. A periosteal flap was dissected and sutured over this. The skin was sewed with a continuous suture of silk. A dry dressing and compression was applied. No anaesthesia was used for the operation.

At the completion of the operation, the child suffered with symptoms of shock, so was given saline solution by rectum while still in the operating room. One hour after the operation, the child was able to nurse.

After the operation, the general condition of the little patient was good, and she was able to nurse regularly up to July 15. Then for two days the temperature arose to  $101.8^{\circ}$  by rectum, and she had tonic contractions of the right foot and hand. These have been the only symptoms we could attribute to a lesion of the central nervous system. Otherwise during the time of her stay in the hospital the child was perfectly normal, and we could not discover any pathological symptoms. From July 17, the child improved, and her appetite increased so that, although nursed by the mother, it was necessary to provide also a feeding bottle to appease her hunger.

July 20, the stitches were removed, and except for a small stitch abscess, the wound was perfectly normal.

The child was discharged from the hospital on July 26, 1914, apparently perfectly well.

*Examination of the Specimen After the Operation.*—Quantity of fluid removed, 1000 c.c.; appearance of the fluid, bloody; specific gravity, 1012; reaction, alkaline; albumen present in great quantity; sugar absent.

A great quantity of red blood corpuscles is found in the microscopical examination of the sediment.

The sac is formed of three membranes easily detachable one from the other, and fused together in the vicinity of the ring, which marks the opening of the sac into the cranial cavity. The external membrane is very little vascularized and of white color. The middle membrane presents a net of numerous large and small vessels, and the internal membrane is very friable. All around the opening leading into the cranial cavity, brainy substance is found attached to the sac. The skin covering the sac at the level of the ring continues with the scalp, and, macroscopically examined, does not show any difference from the common scalp. Part of the specimen was fixed and kept in a 10 per cent. solution of formalin, part of it was fixed with Carnoy's fluid and then kept in alcohol, and part was fixed and kept in alcohol. The pieces were imbedded in celloidin and colored with boric carmin, with hæmatoxylin and eosin, and with toluidin blue. Sections were made of the skin covering the tumor, of the sac in the vicinity of the ring, and of the brainy substance.

*Sections of the Skin.*—The epidermis is perfectly normal, but the corium has no papillary stratum.

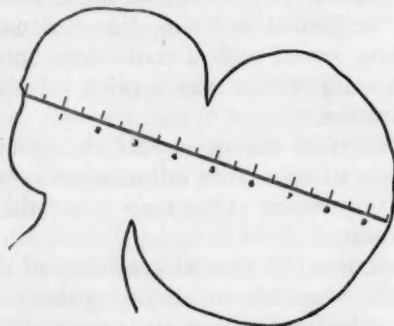


FIG. 3.—Outline of the head and of the tumor taken directly from the patient (scale in inches).

*Sections of the Sac.*—The section of the sac shows that the external membrane is formed of connective tissue, with few small vessels. The middle membrane is formed almost exclusively of large vessels, and the internal membrane is formed of amorphous tissue.

The section of the sac, in the vicinity of its pedicle near its opening into the cranial cavity, shows presence of cerebellar tissue.

The first examination, with a low power objective (Fig. 4), gives the impression that the cerebellar tissue is normal and distinguished by its characteristic lobules, but the examination with a high power objective shows that each lobule is surrounded by a great quantity of blood-vessels, and that the molecular layer instead of being external to the granular layer is internal to it, and the white matter is external to this granular layer (Figs. 5 and 6). In other words, it seems as if each lobule of the cerebellum had been turned inside out like the fingers of a glove, in such a way, that the external stratum of each lobule is brought inside, and the internal part brought outside. In proof of this we find that the cells of Purkinje are found in the internal part of the lobules, while in the substance outside of the granular layer we do not find any ganglionar cells.





FIG. 1.—Condition of the patient before operation.



FIG. 2.—Two weeks after operation.

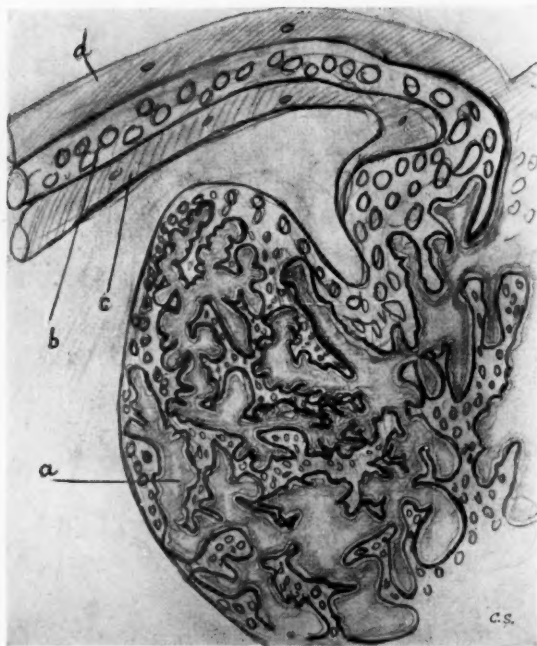


FIG. 4.—View of the section of the sac in the vicinity of its opening in the cranial cavity. *a*, lobules of the cerebellar substance; *b*, middle membrane of the sac; *c*, internal membrane of the sac; *d*, external membrane of the sac. (Oc. 2, Ob. 32 mm.)



FIG. 5.—View of a lobule of cerebellar substance. *a*, granular layer; *b*, molecular layer; *c*, white substance; *d*, vascular membrane. (Oc. 2, Ob. 3 Reichert.)

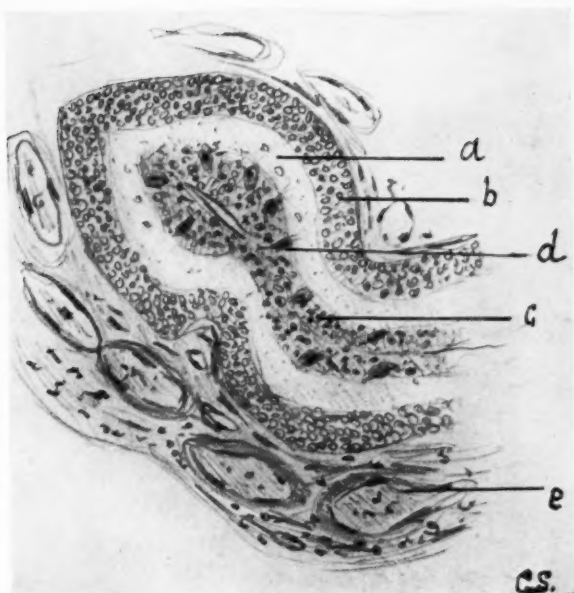


FIG. 6.—Enlarged view of a lamella. *a*, granular layer; *b*, white cerebellar substance; *c*, molecular layer; *d*, cells of Purkinje; *e*, blood-vessels. (Oc. 2, Ob. 4 mm.)

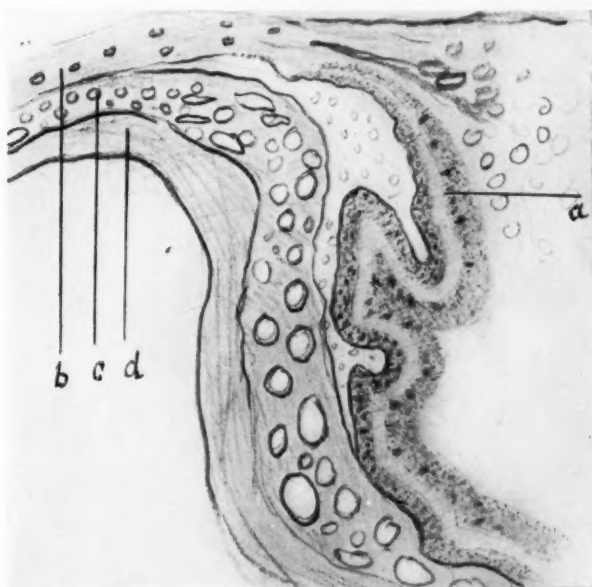


FIG. 7.—View of the termination of the cerebellar substance and its attachment to the external membrane of the sac. *a*, cerebellar substance (the three layers of the cortex); *b*, external membrane of the sac; *c*, middle membrane of the sac; *d*, internal membrane of the sac. (Oc. 2, Ob. 3 Reichert.)

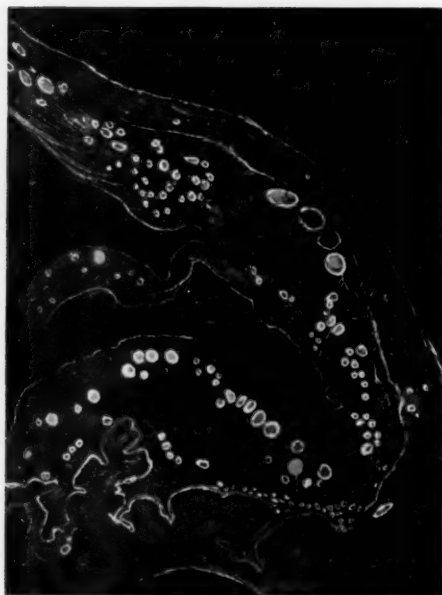


FIG. 8.—Photographic view of the preparation of Fig. 7.

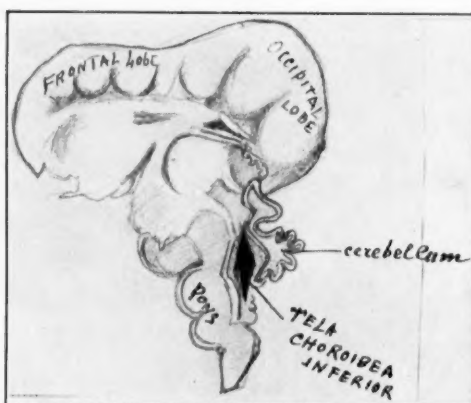


FIG. 9.—Encephalus of human embryo three and one-half months old. (From Poirier and Charpy, modified.)

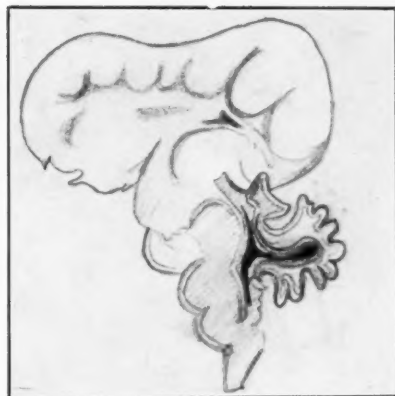


FIG. 10.—Schema from Fig. 9, showing the effect of enlargement of the tela chorioidea inferior.

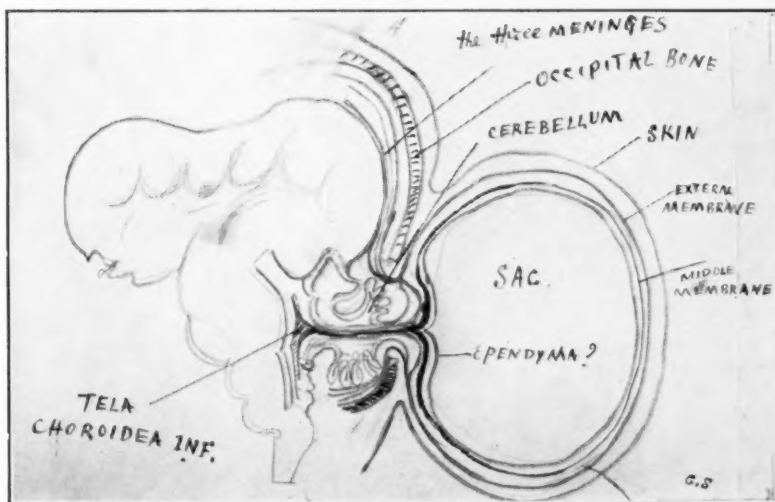


FIG. 11.—Schema from Fig. 9, showing the perforation of cerebellum and the formation of the extracranial sac.



## STRUCTURE OF ENCEPHALOCYSTOCELE

To understand this eversion it is enough to presume that for some reason the central limb of the white matter in the centre of the lobule has been split, and the two parts of the cortex turned to describe an arch of about 300°.

Following the three layers of the cerebellar cortex up to the walls of the sac, I found them attached to the internal part of the external membrane of the sac, and I noticed that these layers, as they approach the walls of the sac, become thinner and thinner, and finally disappear. The first to disappear is the granular layer. Soon after the molecular layer cannot be found, and the white matter is the last to disappear, spreading out into a very fine covering on the internal surface of the external membrane of the sac (Figs. 7 and 8). The cells of Purkinje are not to be found, after the granular layer has disappeared.

The vascular membrane that surrounds each lobule covers all the cerebellar substance of the specimen, and when this substance has disappeared, this vascular membrane continues to cover the external membrane, and thus forms the middle membrane of the sac.

Inside of this vascular membrane, I found some very delicate fibrous tissue which continues to form the innermost membrane of the sac.

In conclusion, the external membrane of the sac is to be considered as the extension, outside of the cranial cavity, of the three meninges of the cerebellum, the dura mater, arachnoid, and pia mater fused together.

The middle membrane comes from the interior of the cerebellum, most probably from the tela chorioidea inferior of the fourth ventricle, or from the choroid plexus of the third ventricle.

The inner membrane is more difficult to explain; probably it is a derivative of the ependymal cells.

### SURGICAL, PHYSIOLOGICAL AND ANATOMICOPATHOLOGICAL CONSIDERATIONS

*Surgical Observations.*—When an infant affected with encephalocystocele is brought to a surgeon, it is advisable, as a general rule, to wait until the child is older to perform the operation. This rule should be imperative when the life of the patient is compatible with the lesion, but it could not be followed in my case, as the tumor was already very large and increasing daily, and presented an area of necrosis in the skin which might endanger the life of the patient by causing septic meningitis.

The formation of two flaps, one superior, one inferior, has many advantages over two lateral flaps, because the line of suture is brought up in the skull and can be better protected by the dressing; the flaps must be liberally large on account of the retraction of the skin and the increasing size of the head.

In regard to the brainy substance found in the sac, it is advisable to reduce only that portion of the brain which requires little manipulation to do so. The rest ought to be removed with the sac.



A sharp excision is less dangerous than any mangling of such a delicate structure. After the excision of the sac, the opening should be closed with a fine suture, in order to prevent necrosis which may occur after ligature of the pedicle.

I think too much importance has been given to the formation of a periosteal flap. Such a flap is difficult to dissect and once sutured it is not sufficiently resistant. It is quite enough to draw together the connective tissue found around the ring with two or three stitches.

*Physiological Considerations.*—Although a part of the right lobe of the cerebellum was removed, at present the only symptoms that could be attributed to the operation were the tonic contractions of the right superior and inferior limbs first noticed three days after the operation. When a total or partial excision of the cerebellum is made experimentally (L. Luciani), the animal shows two orders of symptoms. Some

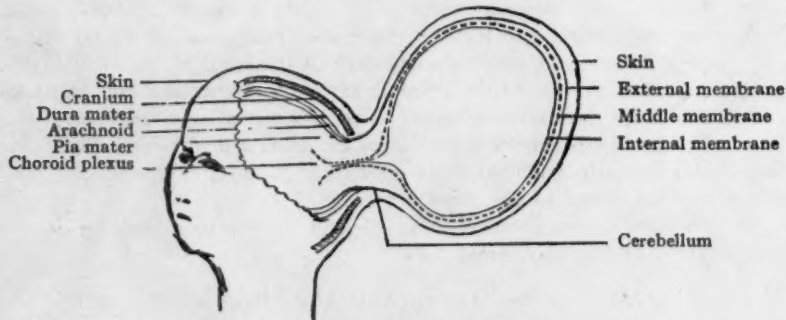


FIG. 12.—Schema of the conditions at birth.

appear soon after the operation and are symptoms of irritation. Other symptoms of cerebellar deficiency, or inhibitory, appear later on and are characterized by the so-called cerebellar ataxy. The tonic contractions observed in my patient on the third day after the operation were evidently symptoms of irritation. My patient is at present too young to permit the observation of any symptoms of cerebellar ataxy. This patient will be an interesting subject to be studied later, as surgical excision of cerebellar substance in the living human being is a very rare occurrence.

*Anatomicopathological Observations.*—From the microscopical findings in this case, it can be presumed that the disease is caused by an active process of some internal structure of the brain. The middle membrane of the sac is formed by a vascular structure, which covers the part of the cerebellum attached to the sac, and evidently comes from the internal parts of the brain. The only explanation of this fact, is



# STRUCTURE OF ENCEPHALOCYSTOCELE

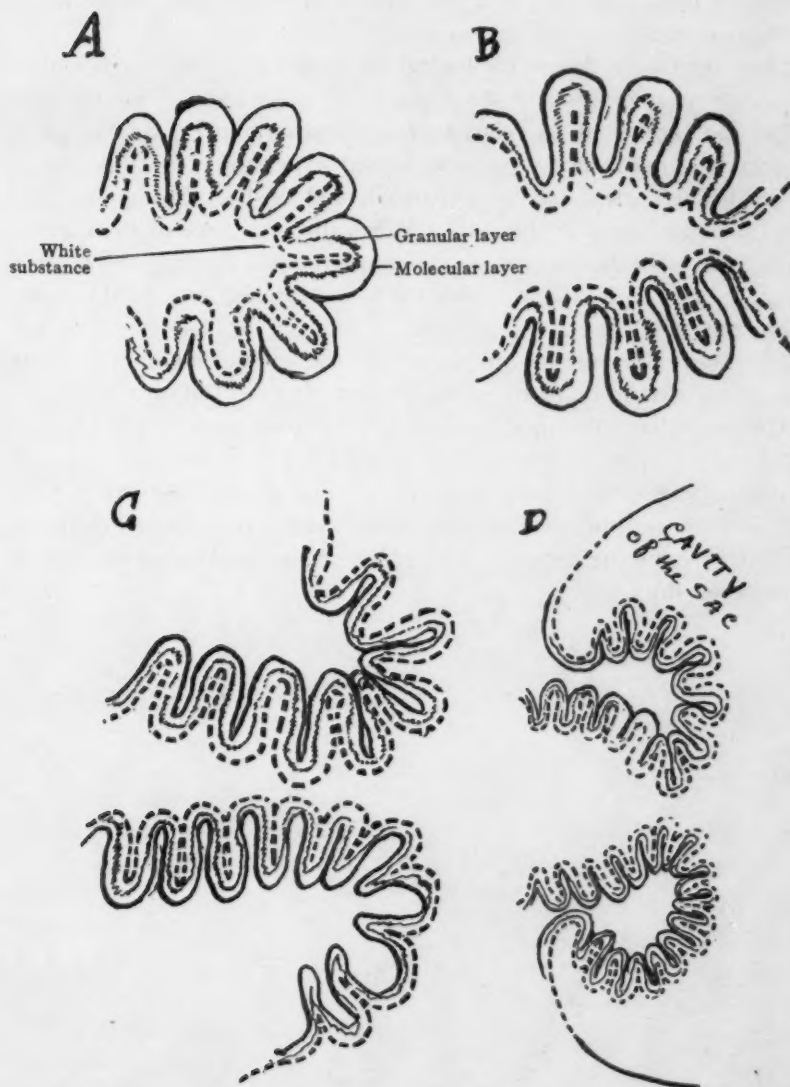


FIG. 13.—Schema 40 show the extroflexion of the cerebellar cortex in the sac. A, normal cerebellar cortex. The internal or white substance is shown by dashes. B and C, different degree of eversion of the cortex. D, the eversion completed.

to consider this vascular membrane as a prolongation of and dependence of some vascular membrane of the brain, as, for instance, of the tela chorioidea inferior of the fourth ventricle or of the choroid plexus of the third ventricle.

If we remember the embryological development of the tela chorioidea and of the choroid plexus in the brain (Figs. 9, 10 and 11) and the position of the cerebellum in relation with these structures, we can easily see that in consequence of a pathological hypertrophy of this plexus, the cerebellar cortex may be expanded, and pushed through an accidental opening found in the skull. When the resistance of the cerebellum is overcome, the choroid plexus may protrude through the cerebellum (Fig. 12) and expand under the skin, forming one of the layers of the sac.

The alterations in the circulation of the middle membrane is the cause of the exudation of the great quantity of fluid found in the sac.

The cerebellar substance, lacerated and pushed aside by the invasion of the hypertrophic plexus, adheres to the walls of the sac and, continuing its development, rolls up, and as a result it extroflexes itself (Fig. 13). In this way the internal part of the cortex is brought externally, and this explains the peculiar appearance of the sections of the lobules of the cerebellum.

# **OBSERVATIONS ON CEREBRAL SURGERY\***

**BY JAMES H. KENYON, M.D.**

**OF NEW YORK**

THIS article is a brief account of the author's personal experience in cerebral surgery during the last fourteen years, and has for its basis the technic developed by the late Dr. Frank Hartley and himself, an account of which was published in the ANNALS OF SURGERY, April, 1907.

This technic has stood the test of repeated use for many years in the hands of numerous surgeons.

This will be described with the modifications and changes suggested by the varied conditions arising during its more extended use. The author, either as operator or as assistant, has had an opportunity in 160 cerebral operations of various characters on every region of the head to note the efficiency and safety of this technic. No accidents or complications have been observed.

As this paper is limited to a description of the operative technic only, no extended report of cases will be included.

The following table shows the regions exposed and the intracranial conditions found in the 160 cases:

**TABULATED STATEMENT OF CASES OF CEREBRAL SURGERY STUDIED**

Region exposed	Tumors	Abscess	Cyst	Exploratory operation	Fracture	Compound depressed fracture	Old fracture and scar tissue	Extradural hemorrhage	Subdural hemorrhage	Laceration of brain and dura	Meningitis	Leptomenigitis	Hydrocephalus	Microcephalus	Jacksonian epilepsy	Total
Frontal.....	1	1	1	1	..	2	..	..	..	..	..	..	..	..	..	6
Vertex.....	1	..	..	..	..	1	..	..	..	..	..	..	..	..	..	2
Lateral.....	16	2	1	9	4	2	4	2	2	1	..	5	..	2	4	54
Parietal.....	1	..	2	2	..	2	4	..	1	..	..	..	5	..	..	16
Occipital.....	3	..	..	..	2	..	..	1	1	2	..	..	..	..	..	9
Cerebellum.....	7	..	..	2	..	..	..	..	..	..	..	..	..	..	..	9
Both lobes of cerebrum and cerebellum. Single flap..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	2
<b>Total.....</b>	<b>29</b>	<b>3</b>	<b>4</b>	<b>14</b>	<b>4</b>	<b>9</b>	<b>8</b>	<b>3</b>	<b>3</b>	<b>3</b>	<b>2</b>	<b>5</b>	<b>5</b>	<b>2</b>	<b>4</b>	<b>98</b>

Gasserian ganglion—excision and division of sensory root..... 62

Total cases..... 160

Celluloid Plates—Regions: Frontal, 2; lateral, 7; parietal, 4; occipital, 4. Total, 17.

The aim has been to devise a method of procedure in operations upon the head which will lessen the risk and difficulties attendant upon the

\* Read before the New York Surgical Society, October 14, 1914.

peculiar anatomical combination of vascularity, dense bone and delicate brain tissue. To attain this end special attention must be directed to the anæsthesia, hæmostasis and gentleness of manipulation. Also to a rapid and certain method of exposure, equally quick and efficient regardless of size of opening, thickness or hardness of the skull. It is also desirable that this exposure be made in such a manner that the opening may be accurately closed and the normal protective cranium restored. Perhaps the greatest emphasis should be placed upon the gentleness of manipulation, particularly in dealing with the lesion after the skull is opened.

**METHODS OF OPENING THE SKULL.**—The various different methods of opening the skull are familiar to all. Each has its advantages and disadvantages and each operator has some particular one that, for him at least, is satisfactory. A few remarks on these different methods follow:

*Chisels, gouges and mallet* have been used to make small openings and large osteoplastic flaps, but the objections, pounding and the danger of injuring the dura and brain, render them undesirable.

*Trephine or burr* with a subsequent enlargement of the opening with the rongeur is satisfactory where the exposure is not extensive and the bone is not to be replaced. The disadvantages are the time and physical effort required to make a sufficiently large opening, particularly when the bone is thick and dense and the surgeon's hand is more or less fatigued and not in the best condition for the delicate intracranial part of the operation.

*Trephine or burr* may be used to make several openings outlining the margins of an osteoplastic flap. A *Gigli saw*, introduced from one opening to another, cuts the intervening bone from within outward either at right angles or at a bevel. This is a simple and efficient method, but thick, dense bone will make the process slow and tedious, with the probable breakage of several saws and the subsequent trouble of passing another. Adherent dura, or dura which has been punctured while making the holes or passing the saw, will be cut or torn by the saw and the cortex possibly damaged and troublesome hemorrhage ensue.

*Trephine or burr* may be used to make one or more holes at one corner of the osteoplastic flap or around its margin. These holes are then united by cutting the intervening bone with one of the various slot-cutting forceps, as DeVilbiss, Dahlgren, or Hudson. To ensure a better fitting flap about one inch of bone between the two holes opposite the hinge or broken edge is cut with a Gigli saw on a bevel.

This method is very quick, simple and satisfactory, provided the

## CEREBRAL SURGERY

bone is not thick or hard and the dura not adherent, in which case it is slow and tedious. The slot is rather wide and does not furnish the best fitting flap. The cutting blade has snapped off and later been found embedded in the brain. The self-locking burrs often used to make the holes are quick cutting and lock just as the inner table is being penetrated, so that further turning is difficult or impossible.

However, on very thin bone this safety-locking feature cannot always be depended upon, and sudden, complete penetration of one to two inches into the brain substance has occurred with unfortunate termination.

*Fraises*, of which there are a number, Sudeck, Doyen, and Cryer, may be used. These are operated by power through a flexible shaft or belt and pulley and are fitted either with a button on the tip or a shoe in which the tip turns to depress and protect the dura.

One or two holes are made, the fraise introduced, the motor started and the slot cut in the desired direction. A slight up and down motion favors the cutting. Thick, hard bone or adherent dura renders the process slow and tedious, with danger of injuring the dura. The slot is too wide to make an accurately fitting bone flap.

*Straight hand saws* of various kinds may be used, preferably after holes have been made along the margins of the flap and the skull thickness measured; for example, the Doyen saw with an adjustable guard originally designed for cutting the lamina.

A *circular saw* operated by power is probably the quickest and best instrument for cutting the bone flap. The slot is narrow and the fit perfect. Thickness or density of the bone does not interfere with or delay the cutting. The operator's hands are not fatigued with the preliminary work of opening the skull. There are several varieties of circular saws devised by Horsley, Van Arsdale, Powell, Marsland, Sudeck, Doyen.

The *Powell saw* is very efficient, safe and convenient. By means of a bevel gear the saw operates parallel to the shaft and handle, giving the operator a good view of the cutting edge. The depth of the cut is regulated by an adjustable shoe which comes in contact with the outer surface of the skull, a preliminary hole having been made to measure the skull thickness. All guards or protectors which are designed to travel between the dura and the inner surface of the skull are theoretically ideal and perfectly protect the intracranial structures, but they are difficult of introduction, jam in the saw cut, catch in uneven bone and adherent dura and are really very objectionable.

The dangers and difficulties attendant upon the use of these intra-



cranial guards are familiar to all operators, and it is due to the feeling that they are indispensable to the use of the circular saw that many have refrained from using the saw at all.

We have proven absolutely by repeated use that the principle of cutting from *without inward* is perfectly safe, without the use of these intracranial guards, provided the precautions to be mentioned later are followed.

Probably the best, safest and quickest of the circular saws and protectors is the type designed by Doyen, which we have modified by omitting the intracranial guard for the reasons above mentioned.

This *Doyen type* (Fig. 1) is an ordinary circular saw  $1\frac{3}{8}$  inches in diameter, fitted with nine strong metal washers  $\frac{1}{8}$  inch thick. Each

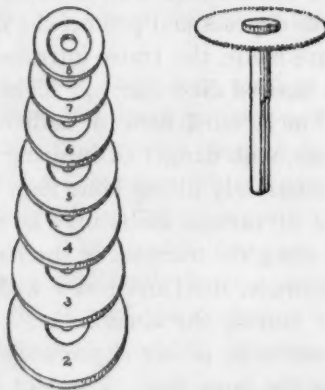


FIG. 1.—Doyen circular saw and washers or circular guards. The figure on each washer means the depth in millimetres that the saw will cut when that particular washer is fastened on the mandril, next to the saw.

washer is stamped with a number indicating the depth in millimetres the saw will cut when that particular washer is fastened on the saw mandril. These washers are strong and when attached really become part of the saw, absolutely and accurately limiting the depth of cut no matter how hard or how long the operator presses on the saw. It therefore only remains that the skull thickness be known and the proper washer selected so that there will be left uncut a thin portion of bone varying from 1 to 2 mm. in thickness. Slanting the saw to the skull surface from  $10^{\circ}$  to  $30^{\circ}$  will vary the depth of cut from 1 to 2 mm. This bevelling process will enable one to cut thinner portions of bone without stopping to change the washer.

Power to operate the drills and saw is obtained from an electric motor or a compressed air motor. A flexible cable transmits the power from the motor to the cutting tool. This flexible cable is sterilized by

## CEREBRAL SURGERY

wrapping with a sterile bandage, but a better method is to boil it or to put it in the steam sterilizer.

The flexible cable, whether made of links or twisted wire, is awkward to move around and being of a fixed length limits the freedom of the operator. Frequently the stand with the fairly heavy motor has to be moved during an operation. The cable chatters, twists on itself and often breaks from too abrupt bending. The dental machine with its belt and pulleys has many drawbacks and its sterilization is difficult. To overcome these objections to the cable the author began experimenting in 1903 with small electric motors, light enough to be held by the operator himself, with the cutting tools connected directly to the end of the motor shaft (Fig. 2).

A metal casing was designed which could be removed in two sections with the wire and sterilized by boiling or by steam and then replaced on the motor just before using. After trying motors of various sizes, weights and speeds, it was finally found that one weighing about 7 to 9 pounds, with a speed of 2600 to 4000 revolutions per minute, which developed about  $\frac{1}{10}$  to  $\frac{1}{8}$  horse power was most satisfactory.

This always furnished an excess of power which was to be desired, and the extra weight gave increased steadiness. A higher speed than 4000 to 5000 revolutions per minute caused the motor and tools to heat unduly and impaired the delicacy of the drilling and sawing.

These motors are wound to run on a direct current of 110 volts. The same motor with a different winding may be used on a direct current of 220 volts, or on a storage battery of 6 or 12 volts.

It has been hard to find a motor for the alternating current which is light enough for the operator to hold and which will develop sufficient power with a moderate speed. Most of the light ones have a speed of 10,000 to 12,000 revolutions per minute, which is highly objectionable. By experimenting we have found that by making one brush on the motor fixed and the other movable, so that their relation to each other may be varied, the motor wound for the 110-volt direct current will work satisfactorily on the alternating current, but the power is diminished and the speed increased.

About ten feet of flexible wire is attached to the casing and is sterilized with it. This wire can be used even while it is wet and has given no trouble. The current should be turned off at the wall socket or by using a foot switch, except during the actual working time of the motor.

This method of obtaining and applying the power from a small motor held in the hand and provided with a removable metal casing

which is sterilized with the wire attached, has many advantages over any other method which has been tried by the author and is original with him. The operator, holding the sterilized motor in his hands, has perfect freedom of motion and by changing hands can saw or drill in any direction. The sterilization is perfect, even of the wire.

The finger switch on the casing and the foot switch on the floor afford the operator a sure and quick control of the current.

The weight of the motor affords steadiness and does not impair the delicacy of touch. The excess of power shortens the time of operation. For boring the hole the late Dr. Frank Hartley and the author designed the cutter shown in Fig. 3. It starts the hole and cuts through to the dura. It cannot slip all the way in because of its flaring cone-shaped sides. The arrangement of the cutting blades is such that a characteristic sound is heard and a different sensation experienced by the hand of the surgeon just as the tip of the cutter is coming through the inner surface of the skull. If the cutter is withdrawn at this moment and the hole inspected, a thin egg shell like fragment of bone will be seen at the bottom, affording ample protection for the dura. Holes in the skull can be made so quickly and safely with this cutter that one does not hesitate to use it as often as necessary over any region or sinus. It seems to be equally safe and efficient whether the bone is thick or thin.

A little sterile solution trickled on the cutting blades facilitates their action. If the blades become clogged with clotted blood and impacted bone, they may be quickly cleaned by scraping with the prongs of a sharp retractor.

METHOD OF ASSEMBLING THE MOTOR AND CASING (Fig. 4).—After the casing, knob, handle and wire have been boiled or steam sterilized, the casing is wiped dry with sterilized gauze, particularly that portion around the wires and binding posts.

The assistant or nurse who is to put the motor together, having cleaned up preparatory to the operation, holds the motor (Fig. 4, *M*) on a sterile towel in the left hand with the brush end on the towel; with the right hand the portion of the shell (Fig. 4, *B*) containing the spindle (*E*) is screwed down as far as possible or until a mark on its edge is opposite a mark on the motor. The right hand retains hold of the spindle end of this casing, turning the motor so that the brush end is upward. The towel held in the left hand is now thrown aside, the other half of the casing (Fig. 4, *A*) slipped into place and held there by screwing on the knob (Fig. 4, *C*).





FIG. 2.—Motor with casing, handle and wire. Weight 5 to 9 pounds. Speed 2400 to 8000 revolutions per minute. About  $\frac{1}{10}$  to  $\frac{1}{4}$  horse power. Made with different windings for 110 volts, 220 volts direct current, also 6 and 12 volts storage battery. The 110 volt motors also operate on the alternating current.

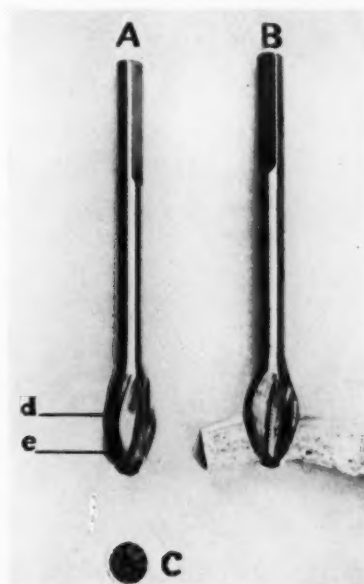


FIG. 3.—A single cutter combining the functions of two of the Doyen cutters. It may be termed a burr drill, and was designed by the late Dr. Frank Hartley and myself in 1905. With it holes may be started and finished without danger of injuring the dura or an underlying sinus. It emits a peculiar characteristic sound just as the inner table is being penetrated. The instrument is withdrawn at this moment, the hole is inspected and found to be just through.

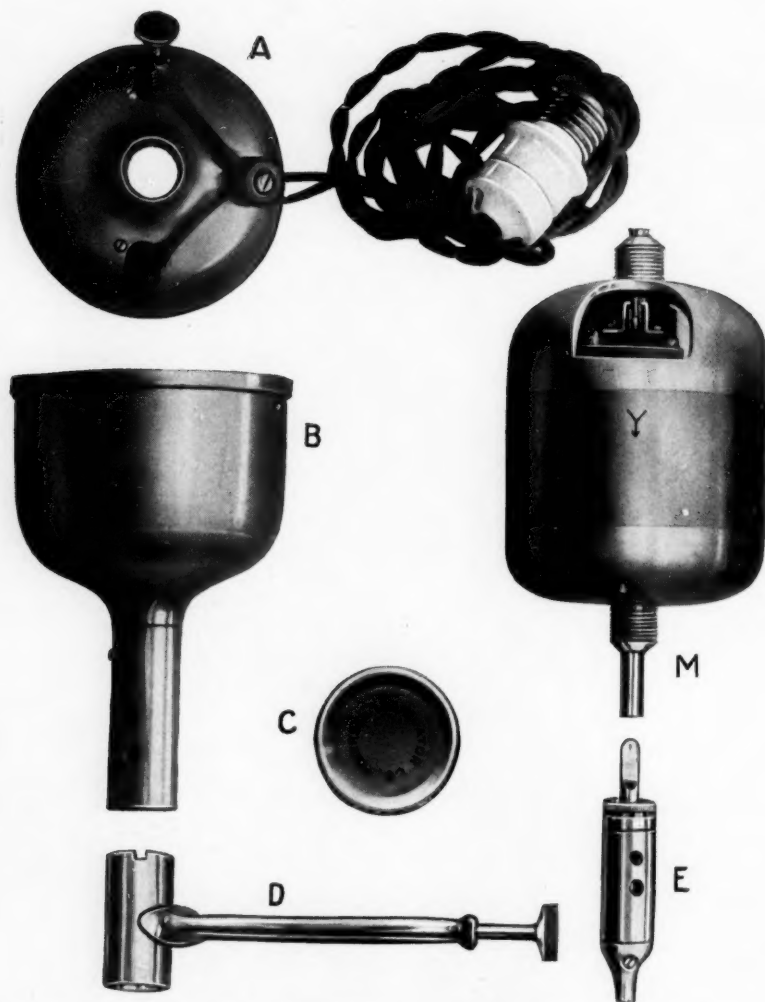


FIG. 4.—Motor and casing taken apart for sterilizing. Everything including the wire, except the motor M, can be boiled or steam sterilized. The spindle E may be fastened in B before sterilizing. For assembling the motor and casing see text.

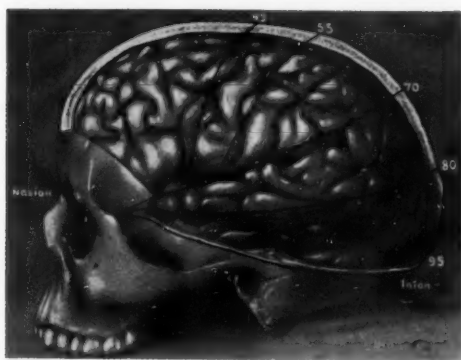


FIG. 6.—Chipault craniocerebral topography.

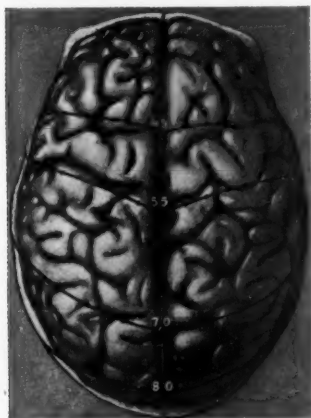


FIG. 7.—Chipault craniocerebral topography as viewed from the vertex.

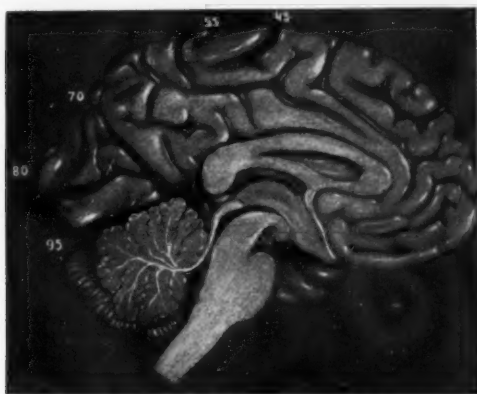


FIG. 8.—Chipault craniocerebral topography as viewed from the mesial aspect of the hemisphere.

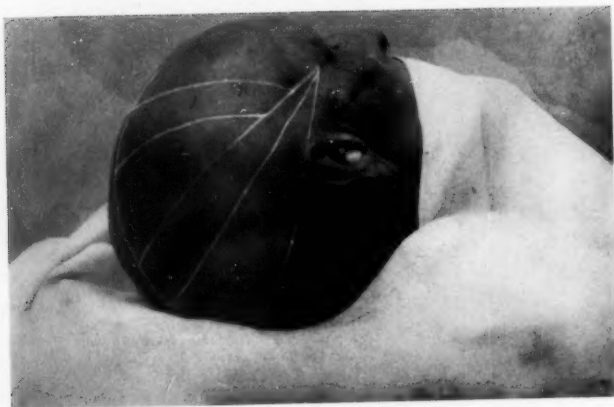


FIG. 9.—Head prepared for operation, Chipault lines for localization.



FIG. 10.—Boring the holes.



FIG. 11.—Measuring the holes.

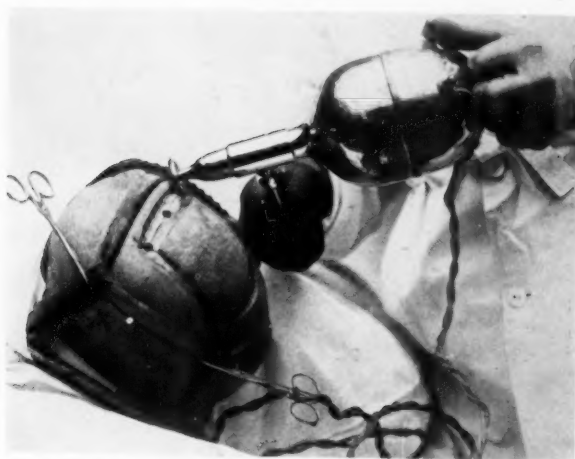


FIG. 12.—Cutting the side of the bone flap with circular saw.



FIG. 13.—Cracking the uncut bone at bottom of saw cut.



FIG. 14.—Prying up the flap, fracturing the bone at its base.

## CEREBRAL SURGERY

The handle (Fig. 4, D) is now attached and the motor is ready for use.

**METHOD OF HOLDING THE MOTOR.**—The knob is held against the palm of the left hand, the thumb and index finger manipulate the switch, and the handle is held in the right hand. It will often be more convenient to reverse this position. When the holes are being made in the skull the motor is started before the cutter is placed on the bone. As soon as it starts cutting firm pressure should be made so that it cuts fairly fast and does not merely spin around and heat up. Always cut at right angles to the surface. The cutter may be lifted out of the hole from time to time to observe the depth of cut, but after a little *experience the change in sound will be a perfectly safe indication* that the drill has just about reached the inner surface of the skull. Whatever thin portion remains may be cracked with the measure.

To obtain the skull thickness the Doyen measure (Fig. 5) seems to be the quickest and best to use. This is gently inserted in the hole. The short projecting tip engages the inner surface of the skull, gentle upward



FIG. 5.—Doyen measure.

traction is made and the thickness noted on the graduated portion. It is often advisable to measure both sides of the hole.

It is well to have a sterile slate and pencil or some one available to draw the outline of the intended bone flap and mark down in the proper places the measured thickness in millimetres. If adjoining holes show a greater variation than 2 mm. more holes should be made. Additional holes should be made on either side of and directly over an important vascular structure, as a sinus. By so doing bone flaps may be made over sinuses without danger of injuring them.

By referring to the diagram with the measured holes the circular saw is fitted with the particular washer or guard which will limit its cutting depth so that there will remain uncut 1 to 2 mm. of bone.

This particular saw and washer may be used wherever the bone thickness gives this margin of safety. The thick portions should be cut first. This same saw and washer may be used over thinner portions by holding it at an angle to the surface or by cutting at a bevel.

However, it is generally safer to change the washer to another which will ensure the proper margin of safety of 1 to 2 mm. of uncut bone.

By this means all the bone between the various holes is cut, either at



right angles or at a bevel, but nowhere is the cut all the way through. *There still remains in every portion 1 to 2 mm. of uncut bone.*

By employing this method the dura and brain cannot be cut.

**CRACKING THE FLAP.**—*A thin osteotome which will enter the saw cut* is inserted in the cut at one of the holes and is tapped with the mallet. The osteotome should be held at nearly a tangent to the skull surface and not at right angles to it. This procedure should be repeated at each side of each hole, particular attention being paid to portions known to be thick. When the thin uncut portion has been cracked in this manner the bone flap is pried up with two or four appropriate instruments, chisels, osteotomes, or periosteal elevators. The operator and the assistant each employ two pries, lifting with one and holding with the other. When the flap begins to lift firm pressure over its base should be made with the thumb and then a quick upward motion given to the edge opposite in order to secure an even break. Upward and outward traction is made on the flap as it is turned down, so that its fractured edge will not damage the dura and brain.

**PREPARATION OF THE PATIENT.**—*General.*—The patient should be under observation long enough to complete thoroughly all the necessary localization tests, such as an examination of the fundus, and of the ears, blood-pressure, etc. It is most valuable to have the specialists in the various departments work together with the neurologist and the surgeon. If possible enough time should be allowed before the operation to put the patient in the best possible shape by proper medication, by diet, or by filling the tissues with fluids if this be indicated.

*Local.*—The local preparation is much the same as for any operation. The entire head should be shaved unless there is some special reason for not doing so, when one-half may be sufficient.

The lines for the craniocerebral localization should be marked on the scalp with carbolic acid fuchsin. All this may be done on the day preceding the operation.

*Craniocerebral Topography.*—Although there is a great tendency to make a quick, rough estimate with a few marks on the scalp and then proceed with the operation, making an exposure large enough to allow for any slight error in localization, it is more scientific and will be found to be of great value to have the topographical lines plainly marked on the scalp.

This will be of great aid in planning the bone flap and in confirming the exact position of fissures and convolutions after the brain is exposed. The flap with the markings may be turned back in place and the projections of the lines on the cortex noted.

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Of all the various methods, that devised by Chipault has proven to be very satisfactory, as it is based upon a percentage of a measured distance on the scalp and, therefore, is equally accurate for all ages and races. Electrodes with a weak faradic current applied to the exposed cortex will confirm the exact location of many centres.

*Chipault Method* (Figs. 6, 7 and 8).—The distance from the nasion to the inion along the median line is measured in centimetres. This median line is marked on the scalp and on it are indicated points, 45 per cent., 55 per cent., 70 per cent., 80 per cent., 95 per cent., of the measured distance from nasion to inion, always beginning at the nasion.

The retro-orbital tubercle on the frontal process of the malar bone is located and a line drawn from it to the 70 per cent. point. This line lies over the Sylvian fissure, is measured and divided into tenths.

The junction of the second and third tenth on this line is joined to the 45 per cent. point, and is the precentral line.

The junction of the third and fourth tenth is joined to the 55 per cent. point and is the rolandic line.

The retro-orbital tubercle is now joined by a line to the 80 per cent. point which constitutes the temporosphenoidal line.

Another line is drawn from the retro-orbital tubercle to the 95 per cent. point which, in its posterior two-thirds, overlies the lateral sinus.

**POSITION OF THE PATIENT ON THE TABLE.**—The patient should be placed upon the operating table and arranged in the position desired, as far as possible, before the anæsthetic is started. For operations on the lateral and posterolateral regions the shoulder of that side should be raised on a sand bag in order to avoid too extreme rotation of the neck. To hold the head from rolling from side to side it should rest in a furrow between two small short sand bags placed close to each other and parallel to the long axis of the body. For operations upon the posterior region, the cerebellum and occipital lobes, the patient should be placed on his abdomen face downward, the forehead supported on a special rest attached to the end of the table, or the forehead may rest on a pad on another table or stand about six or eight inches from the end of the operating table.

A long narrow sand bag is placed under each shoulder parallel to the vertebral column in order to lift the thorax from the table and to afford free respiration. Provision should be made to secure extreme flexion of the neck when desired. This is accomplished by lowering the forehead support or by raising the shoulders by putting larger sand bags under them. The entire body of the patient or the upper portion should be elevated 20° to 45°. A heavy strap should be used to hold the

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thighs to the table to prevent the patient from slipping. This elevation of the head lessens the cerebral congestion and oozing and is changed as occasion requires.

ANÆSTHESIA.—Certain cases with marked stupor and many of the second stage operations can be operated upon with local anæsthesia, the fluid, 1 per cent. novocaine, being injected in and along the line of cut and also into the sensory nerve trunks supplying that region. With this method, however, a small amount of ether may be required from time to time.

The majority of cases will require a general anæsthesia for which ether by the nasopharyngeal or intratracheal method is the best. Special care should be taken to maintain a light, even anæsthesia with no cyanosis. The nasopharyngeal method has both simplicity and efficiency to recommend it. The bottle containing the ether should be placed below the patient's head, preferably hung on the lower bar of the table. The tube in the nostril, one is sufficient, should be as large as can be easily inserted without trauma. It should extend to a point just beyond the uvula, a distance about equal to that from the nostril to the lobe of the ear. Another method which will ensure the proper depth of the tube in the nostril is to insert the tube carefully into the nostril while it is connected to the bottle containing the ether.

When the patient's respiratory movements cause the ether in the bottle to bubble the insertion is sufficient and the tube should be fastened at that depth. This may be easily done by wrapping a piece of adhesive plaster, about  $\frac{1}{4}$  inch wide and 8 or 10 inches long, around the tube very close to the nostril and applying it to the cheek on either side. A second plaster similar to this one adds security.

The ordinary cautery bulb or foot bellows may be used to force the ether vapor into the pharynx. A very excellent method is to connect the oxygen tank to the ether bottle and thus deliver a steady, easily regulated mixture to the patient's pharynx, of air, ether and oxygen.

The tube between nose and bottle should have a connecting link which can be taken apart from time to time to prevent the patient's receiving an excess of ether vapor, for by this snugly-fitting nasal tube considerable vapor is drawn in with each inspiration. In other words, the patient anæsthetizes himself and it is only necessary to regulate the amount. The anæsthesia is started in the usual manner and as soon as possible the change is made to the nasal tube.

For a short time, or until the patient is sufficiently under, both the face mask with the drop ether method as well as the nasal anæsthesia may have to be used. When everything is working evenly the patient is

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put in the proper position, the operative field prepared and the sterile towels and sheets applied.

PREPARATION OF THE OPERATIVE FIELD may be accomplished in various ways. It has been difficult to find any substance for marking the topographical lines on the scalp which is not more or less obliterated by the subsequent sterilization of the skin. Carbolic acid fuchsin is as satisfactory as any. In order to preserve the markings they may be gone over with tincture of iodine on a narrow cotton applicator and then the centre of this sterilized line, which is about  $\frac{1}{4}$  inch wide, is scratched with the point of a scalpel or needle.

The portion of the localizing system applicable to that particular case is thus scratched on the scalp (Fig. 9). After this the remainder of the scalp is prepared. Half or full strength iodine, with or without a previous wiping with benzene or with alcohol or ether, may be used. A generous portion of the head should be prepared so that as many landmarks and as much of the topographical markings as possible may be left uncovered by the sterile towels and sheet.

The towels and sheet should be smoothly applied and securely clamped to the scalp in several places so that there will not be any slipping. For this purpose sharp-toothed towel clamps are made to penetrate the towel and also the scalp. If these clamps are not available a strong suture on a curved needle will answer the purpose. Failure to protect thus securely the operative field greatly increases the danger of infection.

FORM OF FLAP.—The osteoplastic flap should be planned of a sufficient size to extend somewhat beyond the supposed limits of the lesion. The base should be in the region where the bone is thinnest and will break easily, also where the best possible blood supply may be secured. For example, flaps for exposing the lateral portion of the skull, be it frontolateral, midlateral or posterolateral, have their base low down in the temporal fossa.

A description with illustrations of the flaps appropriate for the various regions of the skull was given in the article to which reference has been made. Intracranial lesions located near the midline, whether frontal on the vertex or occipital, are well exposed by making a double flap. Another element to be considered in fashioning osteoplastic flaps is the cosmetic result and the desire to keep the scar as much as possible within the hair line. For example, the Elsberg flap for exposing the pituitary region.

HEMORRHAGE.—The next step is the control of hemorrhage from the scalp, and of all the methods devised, circular, pneumatic, and



regional tourniquets, Kredel plates, clips, clamps and suture of the cut edge, a single row of the modified Heidenhain stitch is the best.

This modified Heidenhain suture of strong catgut is introduced with a full curved needle each time down to the bone, taking in about  $\frac{1}{2}$  to  $\frac{3}{4}$  inch and each time overlapping about half of the previous stitch. This makes a continuous row of overlapped sutures which tightly compress all the tissue between the skin surface and the bone. These are placed about  $\frac{1}{2}$  inch outside of the proposed cut in the scalp, extend across the base of the flap, and completely surround it.

The scalp incision for one side of the flap is now made and should extend with one stroke of the knife down to the bone. Occasionally a few bleeding vessels will appear in the cut edge. These may be clamped and tied with a transfixion suture. When the bleeding from this incision is controlled, the second side of the flap may be cut and then the third. Oftentimes a horseshoe-shaped flap is made instead of three sides of a trapezoid. In any case it is well to make the incision in the scalp for only a short distance at a time in order to secure more thorough hæmostasis. The pressure of the assistant's fingers or flat of the hand along each side of the cut will control the bleeding until the clamp and suture can be applied.

With a sharp periosteal elevator the periosteum is slightly separated from the bone for about one-half inch along the line of incision, but the separation is generally outward, as the attachment of all the soft parts to the bone flap is preserved as carefully as possible in order to secure the best nutrition.

With the cutter shown in Fig. 3 mounted in the end of the electric motor, holes are bored at the corners of the flap and also along the sides, the number being such that between any adjoining two the skull appears to be of fairly uniform thickness (Fig. 10). If this varies more than 2 mm. another hole is bored.

If there is much hemorrhage from the holes bone wax or a piece of muscle or fascia may be pressed in to control it.

An outline of the cut is now drawn and the position of the holes indicated.

At each hole the skull thickness is measured in millimetres from within out by the Doyen measure, and the amount noted on the diagram (Fig. 11).

It is well to cut the thicker portions of the bone first.

The circular saw is fitted with a washer which will cut these thickest portions but will leave uncut the 1 to 2 mm. of bone. The next thinner



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portions may be cut with the same saw and washer by cutting at a bevel which will diminish the depth of the cut by 1 to 2 mm. (Fig. 12).

For the next thinner portions it will be necessary to use another washer. Bleeding from the saw cut may be controlled by bone wax. If it cannot be thus controlled the cutting of the remaining sides is hastened, the bone cracked and the flap turned down as quickly as possible in order to make the bleeding points accessible.

The uncut bone of the inner table is now cracked with the osteotome and the flap pried up (Fig. 13), fractured at the base and turned down (Fig. 14).

Hemorrhage from its edge or inner surface is controlled with bone wax or muscle. The osteoplastic flap is wrapped in a warm towel or gauze pad wet with salt solution, and gently retracted, care being taken to prevent the stripping of the bone from the soft parts.

DURA.—The dural flap is generally made the same in shape as the bone flap, but about  $\frac{1}{4}$  inch smaller on each side so that it may be returned and sutured if possible. A modification of this rule arises when the subsequent suture line would lie over important cortical centres or when, from increased intracranial pressure, the dura could not be sutured.

In these cases it is better to plan the dural flap so that its base or uncut side will protect the important centres under it.

HEMORRHAGE FROM DURA.—Vessels in the dura are best controlled by passing under them a fine curved needle with very fine catgut or silk. To lessen the danger of cortical injury by this procedure the incision in the dura may be made close to the vessel and then the curved needle passed from within outward. Two ligatures are passed and the dura and its vessels cut between them.

HEMORRHAGE FROM CORTEX AND BRAIN.—Hemorrhage from the cortex is controlled by snipping off a small bit of muscle or fascia from the edge of the scalp incision and gently laying it over the bleeding point and carefully holding it there for a few minutes when it will be found to adhere, retaining its position and checking the bleeding. Or moist cotton or gauze soaked in adrenalin may be laid over the bleeding point. Attempts at clamping or tying generally increase the hemorrhage.

Of course, vessels of considerable size may have to be surrounded with a fine curved needle and fine catgut or silk and tied.

The silver wire clips applied with a specially constructed forceps are, at times, serviceable, but often the force or manipulation required to apply the clips tears up more tissue and increases the bleeding.

TREATMENT OF THE LESION FOUND.—If a tumor is found presenting

on the cortex and it seems to be fairly well limited in its extent, the surrounding brain substance is gently pushed away from it with some suitable instrument; an ordinary spoon of appropriate size answers this purpose very well.

By this means the tumor mass is gradually freed from its bed and lifted out. If the growth is below the cortical surface a clean incision at right angles to the surface and over the convexity of a convolution may be made with a scalpel, suitable retractors inserted and the tumor exposed.

If the growth is diffuse its attempted removal is followed by such unfortunate results, both immediate and remote, hemorrhage, shock, paralysis and recurrence, that it is doubtful whether anything more than a decompression should be done. Many factors enter into the decision as to whether or not to remove these rather diffuse growths.

If the diffuse tumor mass is in a silent portion of the brain, away from important centres so that the incision may be some distance from its boundaries, its removal may be attempted.

When situated over important motor centres and considerable paralysis already exists, the removal of the tumor may be undertaken if the dangers of a subsequent increased paralysis have been previously explained to the patient and his relatives.

If removal of the diffuse growth is decided upon, the brain at some distance from it may be carefully tied off with deep catgut sutures, or merely the vessels entering the region are ligated, and an incision with a scalpel made around it. This is deepened with some blunt instrument, as a spoon, and the growth with some surrounding brain tissue scooped out. Hemorrhage from the resulting cavity may be controlled by gentle pressure for a few minutes with moist cotton or vaseline. Or a piece of fat, muscle, or fascia, previously taken from some other part of the body, may be placed in the cavity. These latter substances may be left in place and the dural flap sutured over them.

Brain cysts should be removed with the entire cyst wall, if this can be done, in order to prevent their refilling. When this is not possible they should be opened and drained.

Cerebral abscess is generally secondary to infection in the frontal sinus, middle ear, mastoid, or wound of soft parts or bone.

If possible the abscess should be opened and drained through the same tract or stalk by which it entered. If search is to be made for an abscess deep in the brain a rather large, blunt-pointed needle should be used, or a grooved director, or a long, narrow-bladed knife may be inserted at right angles to the brain surface. The content of the

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abscess is usually too thick to escape through the ordinary aspirating needle. As soon as the pus is located a dressing forceps should be passed along the side of the exploring instrument to enlarge the opening. Then a double suction tube should be introduced and the cavity aspirated as completely as possible. Before the instrument is removed one or two good-sized drainage tubes should be inserted.

It is often difficult to locate these collections of pus in the brain and even more so to procure and maintain efficient drainage. Imperfect drainage probably accounts for many of the long-standing cases of cerebral infection and also for many of the fatal results. One rule should be followed: as soon as the cerebral abscess is located it should never be left without some guiding instrument to its interior, the first should never be removed until another director, probe, or tube has been passed alongside it.

As a retractor on the tumor mass or cyst wall the suction cup as devised by Fedor Krause is very useful. Where the continuous suction is obtainable the cup may be connected to that.

As an adjunct to sponging or a substitute for it, one of the appropriate tips connected with the continuous suction affords a clear field by removing blood and cerebrospinal fluid, lessens trauma to the brain and shortens the time of operation.

**DECOMPRESSION.**—Decompression as advocated by Harvey Cushing is a valuable procedure in many cases. It is to be desired that the area of bone removed be so situated that the uncut muscle can be brought over it to aid in making a firm and elastic covering. The brain thus protrudes gradually and the danger of hemorrhage into the cortex and laceration of the brain tissue is lessened.

Another factor governing the location of the decompression area is the necessity of avoiding important centres. Therefore the subtemporal region on the right side, to avoid speech centres, is the place generally selected. If the protrusion is not expected to be very marked the left subtemporal region is a safe area to choose.

A decompression is generally done by making a trephine or burr opening and then cutting out the surrounding bone with the rongeurs. If the skull is not thick and dense this method is satisfactory.

The circular saw cannot very well be used for this purpose but the burr drill run by the motor will quickly and safely surround the desired area with holes which may be readily connected with any of the slot-cutting forceps. Or the entire area to be removed may be filled with holes close to each other and the rongeurs used to complete the removal. This combined use of the motor-driven burr drill followed by the slot-

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cutting forceps or the rongeurs is very efficient and a great saver of time and energy.

Indications for decompression as a palliative measure are the relief of increased intracranial pressure, thereby lessening the danger that important centres and functions may be entirely destroyed, the greatly increased comfort of the patient and the prolongation of his life. Decompression is also employed as a preliminary to a radical operation for the removal of the intracranial lesion. It is often done on the side opposite the lesion so that when the radical operation is undertaken there will be less trauma to the brain from its rapid protrusion.

In many cases, even with greatly increased intracranial pressure, it is better to plan the first operation as an exploratory one, making a large osteoplastic flap over the site of the tumor. This opening may be sufficient for the radical removal of the growth or admirably serve as a decompression.

The protrusion of the brain through a large opening is less damaging to it than when it is crowded through a small one. With the technic already described a large opening may be made with the electric saw and motor as quickly and with as little shock to the patient as a smaller opening made by other methods.

After the bone flap is turned down and the dural flap reflected a careful estimate is made of the extent of the growth, the problem of its removal and the patient's condition. In certain cases, when the condition of the patient will warrant it, the tumor may be removed at this time. However, for the majority of cases, probably the two-stage operation is to be preferred. If there is much pressure this exploratory operation is converted into a decompression. The dura is left unsutured, and the bone is separated from the soft parts beginning at the fractured edge or base. It is then firmly held with the bone forceps and as much of the bone as desired removed with the circular saw. This portion is generally overlapped by the muscle in the flap and makes an ideal decompression. The entire bone may be removed if desired and only the soft parts sutured in place. After a week or ten days the removal of the growth may be attempted if this is thought best. By this method the advantages of a decompression are obtained and in addition an accurate knowledge of the intracranial lesion. If the intracranial pressure is not sufficiently lowered by this procedure, a subtemporal decompression on the opposite side may be performed at some period before the attempted removal of the tumor.

**EXPOSURE OF THE OCCIPITAL LOBES AND THE CEREBELLUM.**—The posterior portion of the head deserves special attention. For exposure



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of the occipital lobes of the cerebrum the double flap described in the former article is very satisfactory, but the osteoplastic flap principle for exposing the cerebellum and the cerebello-pontine angle has not been used to any great extent. The majority of the lesions in these regions have been exposed by stripping the soft parts from the bone and then removing the bone entirely by means of the trephine and rongeurs. When there is great pressure this bone removal will be necessary anyway and if the bone is thin and not very vascular this method answers the purpose. If the bone is dense and thick this is a long and fatiguing procedure to the patient and to the operator and there may be considerable hemorrhage.

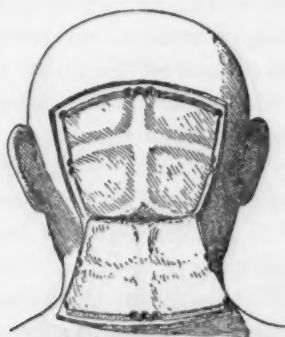


FIG. 15.—Osteoplastic flap for exposing both occipital lobes of the cerebrum and also both lobes of the cerebellum. Many more holes than are shown in the picture should be employed, particularly over the sinuses and transversely across the base of the bone flap. This transverse row of holes fixes the point of breakage so that the margin of the foramen magnum is not injured. The median incision from the external occipital protuberance downward does not show.

Fig. 15 shows an osteoplastic flap for exposing both occipital lobes of the cerebrum and both lobes of the cerebellum. The lateral boundaries extend downward and slightly inward close to the posterior border of the mastoid, just far enough removed from it to avoid opening the mastoid cells. The upper border is about  $1\frac{1}{2}$  to 2 inches above the lateral sinus and the fractured edge is just above the foramen magnum.

To ensure the proper breaking of the flap the bone forming its base is narrowed and weakened by the following procedure: An incision 2 to 3 inches long is made from the external occipital protuberance downward on the neck. This is deepened to the bone. At the desired site of fracture, just above the foramen magnum, the soft parts are separated from the bone with the periosteal elevator, and retracted laterally as much as possible. The burr drill operated by the motor is used to make three or four holes close to each other and extending outward, in order to divide the thickened occipital crest.



At the lower end of each lateral incision the soft parts are separated and retracted inward and the bone weakened in a similar manner. The only uncut portion of bone in the base of the flap is now very narrow and thin and will easily break without endangering the margin of the foramen magnum. The cutting of this flap is the same as that already described for any other region, except that more drill holes are used. Drilling these holes close together is a perfectly safe way of dividing the bone over the lateral sinus. The great variation in thickness along the mastoid and the bone below it will necessitate the drilling of several extra holes close together. By using plenty of holes, which are safely and quickly made, the thickness of the uncut bone between them is



FIG. 16.—In order to afford better retraction and better exposure, the large flap shown in Fig. 15 is split down the middle with the circular saw, cutting from within outward, while the flap is held down as far as possible. After sawing the bone, the soft parts are cut with the scalpel. This gives two equal osteoplastic flaps which may be retracted downward and outward.

accurately known and may be cut with the circular saw without danger to the dura or brain.

Patients with a short thick neck where good retraction is difficult may require a median division of this flap. This is easily done after the bone is turned down by using the circular saw, with or without a washer, cutting entirely through the bone in the median line on the internal surface. The soft parts are then divided with a scalpel, the two osteoplastic flaps are retracted downward and outward as shown in Fig. 16.

The osteoplastic flap for this cerebellar region has many points to recommend it. 1. The hemorrhage is not any greater than in the other methods, probably even less. A Heidenhain stitch controls much of that from the soft parts. The holes and saw cut in the bone bleed only moderately. There is no extensive bleeding because the soft parts are

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not stripped from the bone as in the other methods. The cut can be made with the burr or saw over the sinuses with perfect safety. When the bone is cracked and turned down the vessels extending from the bone to the sinuses and the dura are torn across, but this would happen to the same extent with any other method used. 2. The area exposed is greater. 3. Much less time is required to make even a greater exposure. 4. The thickness and density of the bone does not increase the difficulties of the procedure as the drill and saw work equally well in both thick and thin bone. 5. The one operation gives a good exploratory opening and also a decompression if desired. If, after the flap is made, there is much pressure, the margin of the foramen magnum should be cut away with the rongeurs and a portion or all of the bone in the flap removed. 6. Restoration of the protective cranium is possible. If the pressure is normal or only slightly increased the margin of the foramen magnum may or may not be cut away as desired, but the remainder of the bone flap should be returned to place and the soft parts carefully sutured.

The dural flap to expose the cerebellum may be made in a variety of ways, but the important point is the division between double ligatures of the occipital sinus and cerebellar falx. This greatly increases the ability to retract the cerebellar lobes, inspect their lateral and anterior surfaces and also the cerebellar pontine angle. This exposure according to this technic has been done twice without any difficulties or complications. One case, a beginning basilar meningitis, was done by Dr. W. A. Downes and the author, at the New York Hospital. The patient made an uneventful recovery and was afterward shown before the Surgical Society of New York. The other case, a possible meningitis or brain abscess, was done by the author, at the Fordham Hospital. This case died the following day and the autopsy showed a very extensive general meningitis.

FOR EXPOSING THE CEREBELLAR PONTINE ANGLE in cases where there is little if any increased pressure, Dr. A. S. Taylor has devised an osteoplastic flap shown in Figure 17, and employed it for exposing and dividing the sensory filaments of the facial nerve. The exposure extends from the posterior border of the mastoid nearly to the median line. The upper border is about  $\frac{1}{2}$  to 1 inch above the lateral sinus. Numerous holes are drilled, measured, and the bone cut with the circular saw. The base is undercut and narrowed from each side to ensure the proper line of breakage. The cerebellum is retracted toward the median line and a long slender tube, bent at an angle, connected with the continuous suction, keeps the depth of the wound free from blood and cerebrospinal fluid. A cystoscopic lamp on a flexible holder is placed in one corner

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of the opening and furnishes good illumination of the structures entering the internal auditory meatus.

**REPAIR OF BONE DEFECTS IN THE SKULL.**—Small defects and even large ones if not over important areas may be left alone. The tissue over them thickens more or less and affords fair protection. However, it is generally better to provide some strong, rigid protection for the exposed portions of brain. After the usual preparations a flap of soft parts, about one-half inch larger on each side than the defect, is turned down. Burr holes are made at the corners and along the sides, the bone measured and cut with the circular saw on a bevel, and the narrow strip of bone surrounding the entire bone defect removed. This leaves an opening somewhat larger than the one already present but with clean cut bevelled edges.



FIG. 17.—Single osteoplastic flap for exposing the cerebellar pontine angle where there is no increased pressure and a large opening is not required. Many more holes should be employed than are shown in the diagram.

A sheet of translucent celluloid,  $\frac{1}{10}$  to  $\frac{1}{8}$  inches thick, which has been sterilized by boiling and while warm has been bent to a curvature similar to that of the skull, is laid over the opening and with some sharp-pointed instrument the outline of the opening is scratched on it. The celluloid is now placed on the table and with a fine scroll saw the piece is cut out as marked. This piece is now placed over the opening and minor changes in size and curvature noted. The piece is removed, grasped with a long clamp held in the boiling water, and while hot is bent with the fingers or another clamp to the proper curvature. It is very necessary to have the fit so that the edge will be even with the skull surface but rest securely on the bevelled margin of the opening, so that it cannot be forced in on the brain. A small drill hole is made at each corner and at the middle of each side of the bony margin of the opening. Corresponding holes are made in the plate. If the cortex is

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uncovered by dura, Cargile membrane or a thin sheet of celloidin should be laid over it and tucked under the bony margin of the opening to prevent adhesions. The celluloid plate is then adjusted and fastened in place with chromic catgut sutures and the scalp thoroughly sutured over it. The ease of moulding and fitting the celluloid makes it better fitted for this purpose than other materials, as aluminum or silver. A bone graft from a rib or from the tibia with the periosteum intact may be used, the opening prepared as mentioned above, the bone graft notched, drilled and securely fastened in place so that it cannot slip.

**TREATMENT OF FRACTURED SKULL.**—A simple depressed fracture should be exposed by a flap consisting of the soft parts including the periosteum, and then with a suitable instrument the depressed portion is elevated. To do this the overlapping edge along the fracture line may have to be removed with the chisel or gouge. Another method is to make a few burr holes near the overlapping edge or at the bottom of the depression. These may be enlarged slightly with the rongeurs and then some instrument introduced under the edge of the bone to lift or pry it into place. Still another way after the soft parts have been reflected is to make burr holes at the periphery of the depressed area, measure the thickness and with the circular saw join these holes, crack, and then lift out the entire depressed area. One then inspects the dura for tear and subdural hemorrhage, opens and turns out the clot and stops the bleeding. The depressed portion removed is laid on a smooth, firm surface and with the fingers or a mallet the depression is corrected. The piece or pieces are now returned to their proper place and the scalp replaced and sutured. In many cases an osteoplastic flap cannot be made because the soft parts are more or less separated from the depressed area as a result of the trauma.

Head injuries with symptoms of internal hemorrhage which can be localized or give only the general signs of increased intracranial pressure, embarrassed heart or respiration, or increasing stupor, should be operated upon and in the absence of localizing signs and when the condition does not warrant waiting, a small incision and a small trephine opening over the temporal fossa or occipital lobe or over the cerebellum, with an inspection of and a small incision in the dura if necessary, can be quickly made and quickly closed with a few sutures if nothing is found. This procedure is done at each of the regions mentioned, first on one side and then on the other if necessary.

If the opening gives evidence of hemorrhage or lacerated brain it may be used as one corner of an osteoplastic flap planned to expose this region. The dural flap is then made and the clot removed. The bleeding



is checked and the portion of bone is removed if there is lacerated brain or increased pressure. Rubber tissue drains are then inserted under the dura, and the dura sutured over them if possible. The wound is then closed in the usual manner.

If one feels sure of some intracranial injury, never fail to explore the opposite side, provided that nothing is found on the side entered first. There are a certain number of cases which will have a severe hemorrhage or lacerated brain on both sides and should be treated accordingly. Compound fractures of the skull should be treated as soon as possible after the injury. The original wound is enlarged in a direction which will expose the fracture. A flap of the soft parts may be made. A border of bone  $\frac{1}{2}$  to  $\frac{3}{4}$  inches wide surrounding the fracture should be drilled, measured, and cut with the saw and lifted out.

This method can be done with less hemorrhage and laceration of the brain than would result from cutting away the fractured edge with the rongeurs. If the dura and brain are lacerated and soiled they should be irrigated with sterile salt solution and the ragged tags of dura and loose brain tissue removed. Bleeding should be controlled by applying a small piece of muscle or fascia cut from the edge of the scalp incision. If the bone fragments are clean and there is only slight tendency for the brain to bulge, Cargile membrane or thin sheet celloidin may be laid over the brain devoid of dura, the bone replaced and the soft parts sutured in place with rubber tissue drains in the corners.

In other cases with severe cortical laceration and grave danger of infection the bone removed by the above method is not replaced. Liberal drainage down to the lacerated area should be provided for by rubber tissue drains, the soft parts sutured and a wet dressing applied. This dressing should be kept moist, changed frequently, and the drains moved in and out but not entirely removed for several days until danger of infection is over. At some later time the defect may be closed with a celluloid plate or bone graft.

IN CONCLUSION the following points deserve particular emphasis:

1. The importance of early diagnosis and accurate localization.
2. Early operation in all cases, both traumatic and pathological, before irreparable damage is done to the brain from hemorrhage, oedema, blood clot, sepsis or prolonged pressure. And in the case of a tumor, before it has increased to such a degree as to render its removal impossible.
3. A method of procedure should be selected which combines exploration, radical removal or a decompression, as the lesion seems to indicate. The skull should be opened by a large osteoplastic flap so



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that the intracranial condition may be accurately inspected and radically dealt with if that seems advisable. If the condition is inoperable or a second stage operation is decided upon, a portion of this same bone flap may be removed for a decompression and the remainder sutured in place.

4. The osteoplastic flap, in the majority of cases, furnishes the most satisfactory method of opening the skull and has many points in its favor. It gives the largest possible exposure without increasing the duration or the dangers of the operation. It enables the surgeon to combine in one operation exploration, radical treatment of the lesion, and also all the benefits of a decompression, if that be indicated. It provides by its accurate fit a restoration of the protecting cranium.

H. H. Tooth, in a recent article based on the analysis of 500 cases of brain tumor, states that, "Severe shock at the first stage is not generally repeated at the second stage and is therefore probably due to bone removal." Accordingly anything which lessens the danger of this first stage should be adopted.

5. The selection of a technic and such instruments as will enable the operator to make an osteoplastic flap easily, quickly, and safely with minimum shock and hemorrhage, regardless of size or position or density of the bone.

6. The principle of cutting the skull from without inward is perfectly safe and quick under all conditions. The cutters best adapted for this are the burr drill and the Doyen circular saw protected with washers.

7. The power to operate these cutters is best obtained by using a small electric motor, light enough to be held by the operator, so constructed that the casing and wire may be removed for sterilizing, either by boiling or in steam.

8. Continuous suction applied through a tube of appropriate size and shape furnishes a good retractor for the soft friable tumor mass. Continuous suction applied through a suitable tip, preferably a small, malleable, metal tube which can be easily bent, is a most valuable adjunct to sponging and aids in furnishing a clear operative field, free from blood and cerebrospinal fluid. This is particularly useful in operations on the Gasserian ganglion and for lesions in the cerebellar pontine angle, where the small size of the tube in the wound does not interfere with the operator, although the wound is narrow and deep.

9. Good illumination is most important when the operative field is narrow and deep. This is best obtained by using a cystoscopic lamp on a long flexible metal holder, all of which, including the wire, should be sterilized.

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## LARYNGEAL DIVERTICULA

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OF CHICAGO

DIVERTICULA of the mucous membrane of the larynx which communicate with its interior by means of the appendix of the ventricle are rare. Many of the cases reported in the earlier literature as true diverticula cannot be accepted as such when subjected to critical examination, for the data cited would indicate that the lesion was a thyreoglossal cyst, a vascular struma, or a localized emphysema resulting from perforation of the cartilages of the larynx by some inflammatory process, such as tuberculosis.

Larrey apparently was the first to give an accurate description of this condition. During the Egyptian campaign he saw the first examples of these air tumors which developed in the anterior part of the neck, especially at the side of the larynx, and which he regarded as a variety of goitre. They occurred in the blind who were employed by the priests to shout the verses of the Koran from the minarets. These air tumors developed especially in those who had followed this occupation for a number of years. Finally many were compelled to wear pasteboard collars covered with cotton which enclosed the neck and larynx, in order to prevent distention of the diverticulum and consequent loss of voice. In marked cases the voice was so much interfered with that these people could no longer shout the verses and they were then assigned the duty of tending the fish ponds in the temple.

After returning home from the Egyptian campaign, Larrey observed the same lesion in two of the subordinate officers of the guard. In one of these a tumor the size and shape of an apple was found on each side of the larynx. The tumor was tense and not tender on pressure; the skin covering it unchanged in color, and the surface slightly irregular. Both officers had lost their voices and could speak only in a whisper even when they compressed the swellings. Larrey could cause the swellings to disappear by pressure. Finally the officers had to leave the service because of interference with the voice occasioned by these air tumors.

Some of the cases observed by Larrey were probably not diver-

ticula, for, according to him, the cases were apparently much more frequent than we know them to be at present. The general character and location of the air tumors and the interference with the voice, as noted in the subordinate officers of the guard, are however quite characteristic and leave but little doubt as to the nature of the lesion in some of the cases observed by him. It is interesting to note that Larrey thought these diverticula similar to the buccal pouches of apes, in which food is stored or hidden, whereas they are the analogue of the extralaryngeal extension of the ventricle found in howling monkeys.

Bennett gave the first anatomical description. Other anatomical descriptions have been given by Gruber, Rüdinger and E. Meyer, diverticula having been noted in 8 cadavers. In most of these cases the diverticulum has been bilateral.

The findings in Meyer's case will be cited, as the details regarding the relations of the diverticulum are given. The preparation described by Meyer was found in a man thirty-eight years of age. In this specimen the appendix of the ventricle passed upward as a cylindrical body, between the epiglottis and the inner surface of the thyroid cartilage. The appendix was situated directly beneath the mucous membrane of the false cord and the arytaeno-epiglottidean fold. It measured 2.5 cm. in length and 1.5 cm. in width. Connected to the appendix by a thin pedicle was a sac which, after piercing the thyrohyoid membrane, passed into the neck back of the thyrohyoid muscle, where it formed a large extralaryngeal pouch. This extralaryngeal pouch measured 2.8 cm. in length, 1.3 cm. in width and 1.0 cm. in depth. The left appendix passed 2.1 cm. above the upper border of the thyroid cartilage. Nothing otherwise abnormal was found in the larynx.

The extralaryngeal sac has, in most cases, communicated with the appendix of the ventricle by a constricted part which in some cases has been so narrow that it scarcely permitted of the insertion of a small bristle. Virchow evidently regarded the appendix of the ventricle as pathological, for he states that in addition to the tracheocele, there is found a diverticulum or process of the ventricle of the larynx which may be designated as a ventricular laryngocele. This is usually a thin sac which extends upward from the false cord to the upper border of the thyroid cartilage or even to the hyoid bone, where it ends in a bulbous expansion. This prolongation usually communicates with the ventricle by a narrow orifice. Virchow, when he described this so-called ventricular laryngocele, was apparently dealing with the normal appendix of the ventricle, but the term ventricular laryngocele may well be preserved and applied to the pathological condition under discussion, a cystic dilatation of the ventricular appendix.



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The appendix is, as a rule, placed vertical to the ventricle. The opening of the appendix is found upon the anterior and external part of the superior wall of the ventricle. To see this well the inferior cord must be depressed, so that the lower surface of the superior cord is exposed. When this is done an elongated fissure measuring from 5 to 8 mm. is seen, which begins near the anterior extremity of the superior cord and terminates posteriorly at the junction of the anterior and middle third. The appendix lies within the thickness of the arytaeno-epiglottidean fold, between it and the thyroid cartilage. Its depth varies in different subjects; often there is a difference on the two sides. Usually the appendix does not reach the upper border of the thyroid cartilage. It may, however, extend as high as the hyoid, or so high that it is covered by the mucous membrane of the posterior part of the floor of the mouth. The interior of the appendix is usually divided into a number of small cavities by septa.

Three types of laryngeal diverticula are found: (1) The extralaryngeal; (2) the combined—an extra- and intralaryngeal sac, communicating with each other, being present; (3) the intralaryngeal.

But fourteen cases of laryngeal diverticula which can be accepted without reserve after a critical examination of the data given concerning them have been observed clinically.

*Extralaryngeal Diverticulum.*—In six of these the diverticulum has been entirely extralaryngeal. These cases have been observed by Pantaloni, Pearsall, Herhold, Scheven, Guggenheim and Burger. Four occurred in men and two in women, the patients being aged 25, 2, 24, 41, 29 and 12 years, respectively.

The extralaryngeal diverticulum offers few problems as far as surgery is concerned, for the sac can be easily removed by an operation which is wholly extralaryngeal and there is no tendency, apparently, to the formation of another extralaryngeal or of an intralaryngeal pouch.

The general characteristics of the extralaryngeal diverticulum is well illustrated by the case observed by Pantaloni. His patient, a young man twenty-five years of age, of athletic build, experienced a slight pain on the right side of his neck while carrying a heavy sack of flour up a flight of stairs. This pain did not prevent him from continuing his work, although it persisted for 4 or 5 days. Some time afterwards, while blowing, he noticed a swelling upon the right side of the neck, to which he attached no significance, for it was not painful and caused him no inconvenience. When he pressed upon the swelling a whistling sound could be heard. The swelling gradually increased in size, finally interfering with the motions of the head. He then consulted a physician.

When examined, a tumor the size of a hen's egg, which occupied the entire submaxillary region, was found. It was not adherent to surrounding structures, but seemed to be connected with the thyroid cartilage. It had on palpation an elastic feel, and could be made to disappear upon pressure, when a sharp,



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whistling sound, which evidently came from the larynx, could be heard. This tumor could be made to reappear by forced expiration. The larynx was normal upon laryngoscopic examination, the voice had not been interfered with, and respiration was free.

This mass was exposed by an incision parallel to the border of the lower jaw, at the level of the upper border of the thyroid cartilage. The sac, the size of a hen's egg, was carefully isolated, the submaxillary gland lying above, and the superior thyroid artery to the inner side. A small pedicle passed over the upper border of the thyroid cartilage, just to the right of the incisura. When the sac was opened a point of communication with the interior of the larynx, the size of a pin, was found. The pedicle was ligated and the wound closed in the usual way. There was no recurrence of this swelling after the operation.

This case with the sudden development of the swelling without hoarseness or interference with respiration is typical of the extralaryngeal diverticulum. In some instances the sac has caused so little inconvenience that surgical interference has not been deemed necessary.

*Combined Types (Extra- and Intralaryngeal Diverticula).*—The mode of development, symptoms, and difficulties encountered in treatment of the combined type are well indicated by the case observed by us.

This patient, Mrs. W., age sixty-nine, was examined December 13, 1913. She complained of the following symptoms: Marked hoarseness and a sensation of fulness in the throat associated with a profuse discharge of foul-smelling pus which had to be coughed up almost constantly from the larynx. There was an external swelling in right side of the neck the size of a goose egg, located above and to the side of the upper border of the thyroid cartilage. While the escape of pus was in part spontaneous, large amounts of it could be expressed at once by pressing upon the external swelling in the neck. She was able in this way to evacuate as much as a fourth of a tumbler of pus at a time. This would relieve her for a while of the sensation of fulness in the throat and there would be a partial, but temporary, cessation of the discharge of pus. The annoyance occasioned by the loss of voice and sensation of fulness in the throat was slight as compared to the great suffering produced by the constant escape into the throat of quantities of foul pus. Her sleep was constantly disturbed because of the discharge of pus into the larynx which gave rise to paroxysms of coughing.

Since girlhood she had been subject to frequent attacks of hoarseness which usually came on once or twice a year and lasted sometimes as long as a week, associated usually with symptoms of cold in the head and pharyngitis, but for about twenty years she had been relatively free from attacks of this sort. Three years ago, however, while travelling in Ireland, she developed a hoarseness, associated with severe coughing spells. After one of these coughing spells, she experienced for the first time a sense of pressure and fulness in the throat, and a swelling developed rather suddenly in the right side of the neck in the posterior and lower part of the submaxillary triangle. There were periods when these sensations would



FIG. 1.—The swelling occupying the posterior and lower part of the submaxillary triangle indicates the position of the extralaryngeal portion of the diverticulum. The scar resulted from an early operation during which a tracheotomy had to be performed because of œdema of the glottis. The attempt to remove the diverticulum was then given up. The swelling could easily be reduced by pressure. Pus was coughed up from the larynx and a peculiar whistling sound could be heard when pressure was applied. This is the typical position for true extralaryngeal diverticula.

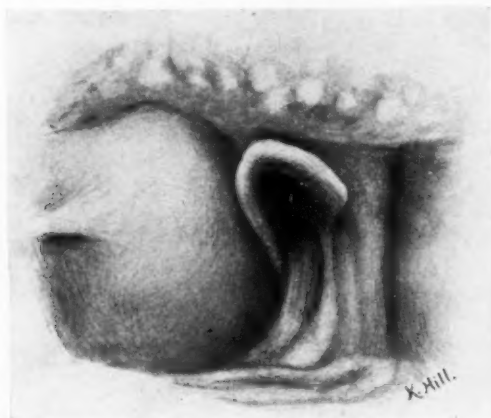


FIG. 2.—View of the intralaryngeal portion of the diverticulum which displaces the epiglottis to the left and covers the false cord upon the right side. The space between the cords is greatly reduced. The edge of the left true cord is visible.



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almost entirely subside, but they never disappeared completely. The hoarseness was always more or less relieved when the other symptoms subsided. On one occasion, while looking upward, with her head tipped back, the swelling in the neck collapsed and with this came immediate return of voice.

One year after the onset of the trouble, a swelling in the larynx was operated upon twice by one of our local laryngologists. The operation was followed by a collapse of the swelling in the throat and return of voice. The relief, however, was only temporary and the original symptoms soon returned. Two months after the last operation an infection of the throat occurred and since that time large quantities of foul smelling pus have been discharged from the sac into the larynx. After failure to get relief by intralaryngeal operations, she consulted general surgeons, one of whom attempted to give relief by external operation. What was done we do not know. A scar is found over the sac, the result of this operation, and a tracheotomy was also performed, undoubtedly because of an oedema of the glottis, secondary to an acute inflammatory process involving the intralaryngeal sac which developed at this time.

Intralaryngeal inspection disclosed a swelling about the size of a walnut, springing from the right side. The right side of the epiglottis was doubled over by pressure of the swelling external to the aryteno-epiglottidean fold. About two-thirds of the cavity of the larynx was filled by this mass which completely obscured the view of the right vocal cord and permitted only an occasional glimpse of the left cord. The surface of this intralaryngeal swelling was smooth and it could easily be indented. Some idea of the appearance of the swelling in the larynx can be had from a drawing made from inspection of the larynx by means of a laryngeal mirror (Fig. 2). The appearance of the external swelling in the neck is shown in Fig. 1.

The diagnosis of a combined laryngeal diverticulum was made. An operation was performed in December, 1913, with the idea of removing the external sac, which occupied the lower posterior part of the sub-maxillary triangle. The large sac, the size of a goose egg, which was filled with pus could easily be dissected free from the surrounding structures, notwithstanding that a previous operation had been attempted but given up because the patient had so much difficulty in breathing that a tracheotomy was necessary. The constricted communication between the external and internal sacs was the size of a lead pencil and passed over the upper border of the thyroid cartilage through the thyrohyoid membrane about 2 cm. posterior to the incisura. When the external sac was removed the cavity of the internal could be easily seen. It was decided at this time to attempt removal of the internal portion by intralaryngeal methods. After splitting the thyroid cartilage somewhat, just anterior to its right upper horn, the tissues forming the wall of the sac were freed and inverted by suture. The hole in the thyrohyoid membrane was repaired and the wound closed in the usual way, drainage being inserted because of the infection in the extralaryngeal sac.

There was a decided improvement in the voice; the sensation of fullness in the throat was less noticeable; and the amount of pus discharged

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from the larynx was much less. On January 9, under cocaine anæsthesia, an attempt was made to reduce the size of the intralaryngeal swelling. An attempt was made to open the intralaryngeal pouch from below upward throughout its entire extent. This was accomplished by using a hook-shaped laryngeal knife. The knife was introduced into the larynx and caught in the lower part of the swelling and by withdrawing the instrument from the larynx the pouch was split to its upper surface. There was an immediate collapse of the cyst and a return of the voice. By using the Krause laryngeal double curette, the edges of the incision were removed piece by piece, until an opening about one-half inch wide had been made. The operation lasted about an hour, as a delay occurred after each step because of bleeding which provoked coughing as long as it kept up.

The improvement in symptoms was marked for a few weeks, but later the symptoms—hoarseness, coughing up of pus, and the expression of air from the sac—recurred to some extent. It is evident that a complete removal of the laryngeal pouch by an intralaryngeal operation is not feasible, for if any of the pouch remains it, as we should expect, fills with pus. The amount of improvement in the patient's voice has not been as much as we had hoped for. On the other hand, the improvement in the most annoying symptom, the secretion of pus into the larynx, has been great. The patient is now able to sleep without being constantly awakened by the secretion of pus. The size of the pouch in the larynx is about one-third what it was before the effort was made to remove it by the intralaryngeal operation.

Five other cases of combined laryngeal diverticula have been reported by Ledderhose, Beausoleil, Benda and Borchert, Avellis and Reich. Three of these occurred in the male, two in the female sex. The ages of the patients being 58, 50, 43, 41 and 30 years, respectively. Benda and Borchert's patient was 43 years old. He had been hoarse for 27 years, but had never had any difficulty in breathing. He had delirium tremens and while struggling violently, he suddenly became cyanotic and died.

At the autopsy the vestibule of the larynx was found to be filled by a hemispherical mass lying in the left aryteno-epiglottidean fold and the left false cord. The swelling was soft, could be made to disappear upon pressure, and filled again spontaneously and rapidly, if the laryngeal cartilages were separated. If a probe was introduced into the left ventricle, it passed apparently under the sinus pyriformis and then upward and lateralward to the base of the tongue. The length of the entire diverticulum was  $4\frac{1}{2}$  cm., the intralaryngeal pouch measuring  $2\frac{1}{2}$  cm. The width of the intralaryngeal pouch was  $1\frac{1}{2}$  cm., that of the extralaryngeal pouch  $2\frac{1}{2}$  cm.

This patient evidently died as the result of sudden distention of the diverticulum during violent muscular exertion, while being restrained. It is the only case recorded in which the diverticulum has become distended so much that it has occluded the vestibule of the larynx. In the case reported by us a tracheotomy was performed at one time, but apparently in this instance an œdema of the glottis had developed as the result of an acute inflammatory process in the diverticulum.



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The symptoms associated with the combined type of diverticulum are caused by the intralaryngeal pouch, which lies in the arytaeno-epiglottidean fold and encroaches upon the vestibule of the larynx. The operative procedures attempted in removal of this pouch have varied. Some of the intralaryngeal operative procedures have been unsatisfactory. As the intralaryngeal pouch is the cause of the symptoms and renders surgical interference difficult and often unsatisfactory, those cases in which there has been an intralaryngeal diverticulum without an extension externally through the thyrohyoid membrane may be considered with the combined type.

*Intralaryngeal Diverticulum.*—Three cases of intralaryngeal diverticulum have been observed. These cases have been reported by Schrötter, Labarre and Hippel. In Schrötter's case the changes developed early and he speaks of it as a congenital abnormality of the larynx. The patient was a boy 8 years old. His voice acquired a peculiar metallic ring after an attack of scarlet fever. The intralaryngeal diverticulum in this case was bilateral. A number of different procedures were attempted in the treatment and finally the false cords and the diverticula were cut during forced expiration by a scissors-like instrument with hooked blades. Afterward pieces of the wall of the diverticula were removed at different times. Finally the right half of the larynx was in good order and the conditions on the left side were satisfactory, although the greater part of the false cord on this side had been removed. The voice was not improved much. It remained much the same as before the operation.

Labarre's patient was a nun, aged thirty. Since youth her voice had been rough without known cause. After an attack of tracheo-bronchitis her voice was much impaired. Breathing was not interfered with much during the day, but at night she had suffocative attacks which became so severe that she was given a night watch in the cloister. Laryngoscopic examination revealed a mass the size of a wild plum which had apparently developed at the expense of the arytaeno-epiglottidean fold and was fused with the base of the same. This mass, which covered a large part of the vestibule, extended beyond the median line and almost reached the opposite wall of the larynx. The size of the mass did not vary much during the different phases of respiration, and because of this the lesion was regarded as a cyst of the arytaeno-epiglottidean fold.

The mass was punctured with a galvanocautery but no fluid escaped and the size did not change. The mass was then divided with a loop of a galvanocautery and the correct diagnosis made. The voice became normal immediately after the operation and since then the patient has had no trouble with voice or respiration.

Hippel's patient was a woman, thirty-four years old. When she was 14 or 15 years of age, she had at times spells of coughing when she became hoarse. During the periods when she was free from coughing the voice was clear, but rougher and deeper than a woman's voice at her period of life should be. When 23 years old she became very hoarse, and during the night developed a stridor. Respiration was free, although there was some difficulty on deep breathing and exertion. The patient at this time visited the surgical clinic and an incision was

made, apparently intralaryngeal, which permitted of the escape of pus. A few years afterward these same symptoms were repeated and an abscess was again opened by an intralaryngeal procedure. When examined December 26, 1909, by Dr. Weyl, the lymph-nodes upon the left side of the neck were somewhat enlarged and when pressure was made there was some discomfort, but not any marked tenderness. Laryngoscopic examination revealed upon the left side of the larynx a large mass, which filled the greater part of the lumen of the larynx and appeared to develop from the neighborhood of the left arytenoid cartilage. The aryteno- and pharyngo-epiglottidean folds were obliterated and the pyriform sinus could not be seen. The mass apparently passes over into the lateral wall of the pharynx. Nothing can be seen of the left cord. A probe revealed that the mass was tense and its surface smooth, like a cyst.

The diagnosis of suppurative inflammation of the left arytenoid cartilage with abscess formation was made. An incision was made into the mass under local anæsthesia, and a large quantity of foul, blood-stained, thin pus escaped.

An examination made on December 28, 1909, revealed that the conditions within the larynx had improved somewhat. The true and false cords on the left side could not, however, be differentiated from each other, and they apparently did not move during attempts at phonation. The right cord compensated by swinging across the median line. During the next few days, in spite of frequent irrigation and gargling with hydrogen peroxide, the *foetor ex ore* continued, the swelling became more marked, the region about the left arytenoid cartilage was discolored gray, resembling somewhat gangrene.

As the condition had not been improved by repeated intralaryngeal operations and there was danger of an acute oedema of the glottis, it was thought best to perform a laryngofissure.

On January 28, 1910, a low tracheotomy was performed, which was made difficult by large dilated veins. A tampon cannula was inserted through which the anæsthetic was administered. The median incision was then continued upward to the hyoid and the anterior surface of the thyroid cartilage was exposed. The thyroid and cricoid cartilages were then divided in the median line and the two parts were separated by retractors. The region of the left vocal cord was then found to be occupied by a large hemispherical mass, with a broad base which completely covered the ventricle so that the opening into this could not be found. The mucous membrane covering the mass was highly reddened and bled profusely when touched. The mucous membrane was then painted with a 20 per cent. novocaine-suprarenin solution to render it insensitive and reduce the amount of bleeding. The larynx below the glottis was tamponed with iodoform gauze and the mass incised parallel to and the length of the false cord. A half teaspoonful of foul-smelling pus was discharged. The incision was prolonged over the arytenoid cartilage to determine whether the cartilage was necrotic or a foreign body present. Neither was found. When the edges of the incision were retracted a cavity the size of a walnut lined with mucous membrane was found. This cavity extended below to the lower border of the thyroid cartilage, above to the base of the tongue; laterally it was limited by the thyroid cartilage, and posteriorly it encroached upon the median line of the larynx. The cavity was oval in shape, folds of mucous membrane projecting into it from the walls of the cavity.

Enucleation of the sac from the cavity of the larynx was considered im-

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possible. Therefore a strip of iodoform gauze was packed in the cavity and another was introduced into the cavity of the larynx. The cricoid cartilage was closed by suture and the thyroid gland which had been displaced downward was placed over the suture line. The tampon cannula was replaced by an ordinary one and the wound closed.

It was soon discovered that it would be impossible to close this cavity by packing and intralaryngeal methods. Besides the tracheotomy tube had caused an erosion of the trachea. It was decided therefore to attempt removal of the sac. On February 9 the tracheotomy tube was removed. There was no disturbance of respiration and the patient could phonate moderately well.

On February 28 the patient was again anesthetized, an incision was made to the left of the median line, which extended from the hyoid bone to the cricoid cartilage. The infrahyoid group of muscles was divided transversely; the thyroid cartilage was divided longitudinally, and both the thyrohyoid and cricothyroid ligaments were incised to permit of retraction of the cartilage outward. The space between the thyroid cartilage, the laryngeal mucous membrane and pharynx was thus exposed. It was difficult to differentiate tissues, because of profuse hemorrhage from numerous capillaries, and attempts to aspirate pus from the diverticulum were unsuccessful. Finally, Hippel succeeded in opening the sac. It was empty and presented much the same appearance that it did at the first operation, the cavity being lined by a highly reddened mucous membrane thrown into numerous folds.

Posteriorly and laterally the sac rested upon the pharyngeal wall; medially and posteriorly it was related to the mucous membrane of the larynx; anteriorly and laterally it rested upon the thyroid cartilage. In the last position the sac was dissected free with great difficulty. The pharyngeal wall was torn in two places during removal of the sac, but immediately closed. About  $\frac{1}{4}$  of the sac was so adherent that it was allowed to remain, the mucous membrane being removed with a curette. The upper and lower lips of the opening into the larynx remained and these were sutured so as to exclude the remaining cavity from the interior of the larynx. The cavity remaining after removal of the diverticulum was packed with iodoform gauze which was brought down below the thyroid cartilage into the neck. The cartilage was then sutured and the wound closed.

The patient made a good recovery from the operation. When examined on May 17 the voice was strong but rough. Laryngoscopic examination revealed no evidence of reformation of the diverticulum. The right half of the larynx was normal. The vocal cord could be seen throughout its entire extent. The left true and false cords could be differentiated and the slit-like entrance to the ventricle could not be found.

But two cases, besides our own, of combined laryngeal diverticulum have been subjected to operation. Ledderhose's patient was a man fifty-eight years of age, whose voice had always been rough. Two years before consulting a physician he noticed a small swelling near the larynx which could be made to disappear by pressure. By firmly binding a cloth about the neck this swelling could be in greater part held back. When the swelling developed in the neck the hoarseness increased, a cough developed, and mucus expectoration was noted. There also developed difficulty in swallowing, particularly of fluids, part of which was regurgitated through the nose. At night, especially when lying

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upon the right side, in which position the swelling in the neck filled, dyspnoea was apt to develop, and because of this the swelling had to be frequently emptied. During forced expiration there developed in the right thyrohyoid region a tympanitic swelling the size of a child's fist, which extended above somewhat beyond the hyoid, anteriorly nearly to the median line, posteriorly to the sternocleidomastoid muscle, and below to the cricoid cartilage. It could be made to disappear by pressure, at which time was noted a loud gurgling, splashing sound. The opening in the thyrohyoid membrane could be felt with the palpating finger when the swelling was not tense. Laryngoscopic examination revealed upon the internal wall of the larynx a broad based, flat, rounded mass, which originated in the right arytaeno-epiglottidean fold and hung over the rima glottidis, extending almost to the left wall of the larynx. When pressure was made upon the external sac this swelling moved to the left, and regained its former position when the pressure was removed. When the external sac was emptied, the internal one barely reached the median line and was reduced almost one-half in size. The mucous membrane covering this swelling was reddened. The false cord was not visible. The point of communication of the external sac with the interior of the larynx could not be determined on laryngoscopic examination.

Because of the marked symptoms Lücke removed the external sac. This was easily separated from the surrounding tissues, except on the anterior surface of the right half of the hyoid. At the point of exit of the sac through the thyrohyoid membrane, the communication with the interior of the larynx being the size of a finger, the pedicle was ligated and then closed by layer sutures.

After this operation the laryngoscopic picture was not changed. Six weeks later the point at which the external sac pierced the thyrohyoid membrane was firmly closed, but the intralaryngeal sac had become larger, so that it completely overlapped the cords. Numerous attempts were made to puncture the sac by intralaryngeal methods. At one time several drops of a clear, thick, gelatinous material were obtained, but usually only blood and air. The swelling decreased one-third in size; the left cord became visible; the symptoms were less marked and the patient was discharged.

Four and one-half years later the patient returned because of marked dyspnoea. At night the patient had attacks which were suffocative in character. Examination showed that there was no reformation of the external sac. The intralaryngeal sac extended over the median line. A fold of mucous membrane, which during respiration floated up and down, extended from the posterior part of the base of the swelling over the right arytenoid cartilage.

An operation was performed to remove the intralaryngeal sac. After a tracheotomy had been performed and a tampon cannula inserted, the larynx was divided throughout the entire length. The sac which lay at the border of the epiglottis was collapsed. It was ligated at the base and cut away. The extirpated portion corresponded to the part which hung over the vocal cords into the cavity of the larynx. The outer wall of the diverticulum lay upon the inner surface of the thyrohyoid membrane. The remaining portion of the diverticulum could easily be separated from the surrounding tissues. A narrow process of the sac extended backward to the arytenoid cartilage and was dis-



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sected out. This process was in the fold of mucous membrane which was seen posteriorly in the laryngoscopic examination.

Following the operation there was some necrosis of the margins of the thyroid and only a small part of the right vocal cord could be seen posteriorly. The greater part was obscured by the false cord, and during phonation the cord did not reach the median line. The voice remained rough and hoarse, but respiration was free.

Reich has recently reported a case of combined diverticulum which was operated upon successfully. His patient, a woman aged thirty, could speak normally and even sing, up to the autumn of 1912. During October and November of this year hoarseness developed without known cause. The degree of hoarseness varied and during the following March there were eight days during which a marked improvement was noted. Since that time, however, the hoarseness has remained unchanged and has been so marked that the patient had to make an effort in order to make those about her understand. There was no difficulty in swallowing. There is usually no dyspnoea, but in recent times there has been considerable dyspnoea when the patient makes an extra effort, and this has been increasing. The patient has had no cough and has had no trouble with expectoration.

In October, 1912, when the hoarseness came on, a swelling developed in the right side of the neck which increased slowly in size and caused but little inconvenience. This swelling occupied the posterior and lower part of the submaxillary triangle. It extended upward to the lower border of the mandible; posteriorly to the anterior border of the sternocleidomastoid; anteriorly to within two fingers' breadth of the median line, and below to the upper border of the thyroid cartilage. The tumor was the size of a hen's egg. When pressure was made upon this swelling, the intralaryngeal mass was not greatly reduced in size, but it was displaced toward the left side of the larynx.

The external sac was aspirated and the 20 c.c. of air removed. The external swelling then disappeared completely and the intralaryngeal one collapsed, so that during attempts at phonation the entire free border of the right cord could be seen and its movements were perfectly normal. A quarter of an hour after aspiration without any effort on the part of the patient, both the extra- and intralaryngeal sacs had filled. The X-ray revealed the extent of this air-containing sac.

The laryngoscopic examination revealed a broad based swelling, which developed from the right false cord. It was about the size of a cherry and hemispherical. During quiet breathing this mass completely covered the right vocal cord and during phonation it extended beyond the median line and touched the false cord on the opposite side. A small part of the right vocal cord could be seen posteriorly near the arytenoid cartilages. A part of the left vocal cord was also covered during phonation. The entrance to the ventricle could not be found. The surface of the swelling was smooth, reddish-yellow in color and injected. The mucous membrane presented no evidences of any marked inflammatory changes. The sinus pyriformis on each side was deep. The size of the swelling did not change during phonation. The left side of the larynx was normal.

The operation was performed under pantopon-scopolamine and  $\frac{1}{2}$  per cent. novocaine-adrenalin anæsthesia. A transverse incision, which extended from the



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anterior border of the sternocleidomastoid muscle to a little beyond the median line, was made over the extralaryngeal diverticulum. The anterior part of this incision was later carried down to the middle of the thyroid cartilage. The external diverticulum was readily exposed after the superficial structures had been divided. The submaxillary gland was directly above the sac, and below the gland were the posterior belly of the digastric, the hypoglossal and superior laryngeal nerves and the hyoid bone. Lateralward the sac extended to the anterior border of the sternocleidomastoid; below it extended a little beyond the upper border of the thyroid gland; and medianward it passed beneath the thyrohyoid muscle. After transverse division of the omo-, sterno- and thyrohyoid muscles and exposure of the anterior surface and upper border of the thyroid cartilage, a pedicle the size of the little finger, the communication between the external and internal sacs, was found. This passed through the thyrohyoid membrane  $1\frac{1}{2}$  cm. lateralward to the incisura thyroidea. The membrane was incised and the pedicle dissected free. Then by making traction upon the external sac and pedicle, the internal sac was separated, partly by blunt, partly by sharp dissection from the structures in the aryteno-epiglottidean fold. When traction was exerted upon the pedicle dyspnoea developed and the patient became nervous. During the dissection an opening was evidently made into the ventricle, for during forced expiration air was expelled. A fold of mucous membrane, evidently part of the false cord, floated into the interior of the larynx, interfering with respiration. This was sutured to the upper border of the thyroid cartilage. The wound was closed by layer sutures, a small drain being placed down to the thyrohyoid membrane in order to prevent an emphysema, if the sutures would not hold.

The recovery was complete. The voice is the same as before the development of the diverticulum and respirations are free.

The cases observed by Beausoliel and Avellis were not operated upon. The patient observed by Beausoliel was a male, aged fifty. For five years nasal breathing had been difficult. At times the nasal passages were completely occluded. For three years he had had a long continued bronchitis, associated with severe attacks of coughing which resisted treatment. One and a half years after the beginning of the attacks of coughing the voice became rough and a small swelling was noted upon the right side of the neck, somewhat in front of and below the great wing of the hyoid bone and 4 cm. behind the incisura thyroidea. Upon laryngoscopic examination a swelling covered with reddened mucous membrane, measuring 1 cm. in length and  $\frac{1}{2}$  cm. in width, was found in the right aryteno-epiglottidean fold. At first sight this appeared like a true eversion of the ventricle.

The nasal polypi were removed in this case. The diverticula were not touched.

Avellis' patient was a girl, aged four years. The size of the extralaryngeal diverticulum is the most interesting feature of this case. When the child cried there slowly appeared, first upon the right, then upon the left side, near the thyroid cartilage, a soft tympanic swelling, which extended upward to the lower border of the mandible, below almost to the clavicle. There was no respiratory difficulty. Operation was postponed as there were no indications at the time of examination for removal of the sacs.

Median laryngoceles have been described by Hutchinson, Madelung, Courtil-

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lier and Pelletier. These have all probably been secondary to an inflammatory process in the larynx, which has resulted in a perforation of the larynx leading to a localized emphysema. In three of the cases there have been distinct evidences of tuberculosis. In Madelung's case the walls of the swelling were composed of degenerated muscles, infiltrated with tuberculous granulation tissue, and in Pelletier's case there were also distinct evidences of tuberculosis in the sac. In the case reported by Courtillier there was neither mucous membrane or endothelium upon the interior of the sac.

Meyer has found in the lower apes a median air sac which varies considerably in size. The opening into this sac is usually found at the base of the epiglottis. From this a funnel-shaped depression passes over the incisura thyroidea, which expands to form a sac which lies anteriorly between the hyoid bone and thyroid cartilage.

No case of a diverticulum the analogue of the median air sac in the lower apes has been described in man, and the median diverticula cannot be regarded as true diverticula, in which the lining is formed by the mucous membrane of the larynx.

(1) The sudden formation of the diverticula and the early age at which symptoms often develop, would indicate that they are probably congenital, and that they are analogous to the lateral air sacs found in howling monkeys.

(2) The true diverticula are constant in their position, appearing either as the extralaryngeal, intralaryngeal, or combined type. The extralaryngeal sac can be removed easily, as in most cases the pedicle is small and there is little or no intralaryngeal prolongation.

(3) The intralaryngeal and combined types are best treated by excision. In cases in which the intralaryngeal sac cannot be enucleated after incision of the thyrohyoid membrane, the thyroid cartilage may be split longitudinally in front of the superior horn. By this method the enucleation of the internal sac can be made practically extralaryngeally.

Intralaryngeal methods, consisting of splitting of the sac and partial removal of the wall, are unsatisfactory, for the posterior extension of the sac is removed with difficulty if at all. Air and pus collecting within this extension causes a recurrence of symptoms.

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## THE RÖNTGENOLOGIC DIAGNOSIS OF SURGICAL LESIONS OF THE STOMACH AND DUODENUM\*

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THE object of this communication is to report a series of cases furnishing data which may help to solve two important questions:

First, is there reason to believe from our present experience that the Röntgen ray will eventually prove as valuable for the diagnosis of surgical lesions of the stomach and duodenum as for the diagnosis of fractures and urinary calculi?

Second, what method of Röntgen examination gives the most accurate results? In the first question it will be noted that we have used for comparison only the diagnosis of fractures and urinary calculi. While röntgenology has proved of great assistance in the solution of many diagnostic problems, such as joint and bone diseases, pulmonary tuberculosis, aneurisms, sinus infections, etc., the surgeon accepts the röntgenographic evidence of fractures and renal and ureteral calculi as final, and of greater value than the clinical history or the results of a most painstaking physical examination, or both methods combined. As a result of the accuracy with which these lesions are recognized by skilled röntgenologists, few if any experienced surgeons of the present day will accept the responsibility of treating a complicated fracture or of advising surgical intervention in a case of urinary calculi without the aid of a röntgenologic examination, if it is possible or practicable to obtain one.

What then is the present status of röntgenology in surgical lesions of the stomach and duodenum? A brief review of the history and development of gastro-intestinal röntgenology may help to answer this question.

The first report on röntgenographic examination of the human stomach was published by Hemmeter in 1896.<sup>1</sup> Early röntgenograms of the stomach were blurred and unsatisfactory, because long exposures were required. The fluoroscopic screen was therefore the more success-

\* Read before the American Surgical Society, April 9, 1914.

<sup>1</sup> Hemmeter: Photography of the Human Stomach by the Roentgen Method, Boston Med. and Surg. Jour., p. 609, June 18, 1896.



ful method until instantaneous röntgenograms were made possible by the advent of the intensifying screen. Not long afterwards, Kaestle, Rieder and Rosenthal<sup>2</sup> reported their bioröntgenographic observation of the gastric motor phenomena; but subsequent publications fail to show that they have taken advantage of this valuable method for practical diagnosis. Inspired by their work, we started by making 12 röntgenograms in rapid succession. This number has been gradually increased until now we always make 40 and usually 50 or 60 röntgenograms in several series, with the patient in various postures, and at intervals of two hours, until the stomach is empty, a method to which the name serial röntgenography has been applied. These röntgenograms are studied individually and collectively and superimposed upon each other for comparison, or reproduced cinematographically.

Recently we have perfected a true röntgenocinematographic machine capable of making 50 röntgenograms of a single cycle, or 200 röntgenograms of the progression of an individual peristaltic contraction from the fundus to the pylorus in a 4-cycle type of stomach. The information gained by such an examination or by serial röntgenography includes:

Size, position and shape or type of the stomach.

Activity of the peristalsis, and width of the peristaltic contractions.

Character of the systole and diastole.

Depth of the rugæ and the direction in which they run.

Degree of dilatation, and the motor phenomena of the descending and horizontal duodenum.

Pyloric sphincter, whether clear-cut and well defined on both surfaces and  $\frac{3}{16}$  inch wide, or irregular in contour and wider than normal.

Cap (pilleus ventriculi), whether symmetrical, corresponding in size and contour with the pars pylorica, or invisible, deformed, or spasmodically contracted.

The first inch and one-half of the gut, beyond the pyloric sphincter, viz., the cap (pilleus ventriculi), is stomach and not duodenum, considered embryologically, histologically, physiologically, anatomically and surgically. The cap is the most important portion of the whole gastric tract, and its röntgenologic appearance is of inestimable value in the diagnosis of lesions in the right hypochondrium.

The diagnosis of extensive gastric lesions is based on permanent filling defects in the walls of the stomach or cap, whereas the diagnosis of early lesions, particularly of small, indurated ulcers and adhesions, is based on the interruption of peristaltic contractions as they progress

<sup>2</sup> Kaestle, Rieder and Rosenthal: The Bioröntgenography of the Internal Organs. Arch. of the Roent. Ray, June, 1910, p. 3.





FIG. 1.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Ulcer of the cap. Surgical findings: Ulcer of the cap. Case I.

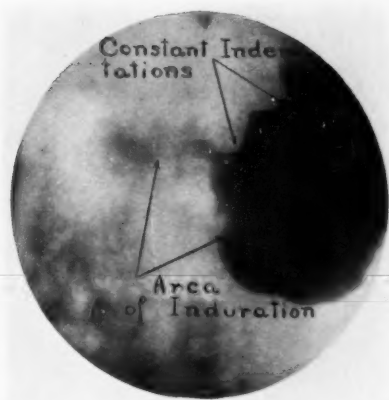


FIG. 2.—Clinical diagnosis: Gastric ulcer. Röntgenologic diagnosis: Gastric ulcer, with extensive induration, extending along greater and lesser curvatures of entire pars pylorica. Surgical findings: Massive, gummatous induration, occupying pyloric extremity of stomach and extending from greater to lesser curvature. Chronic ulcer. Case II.

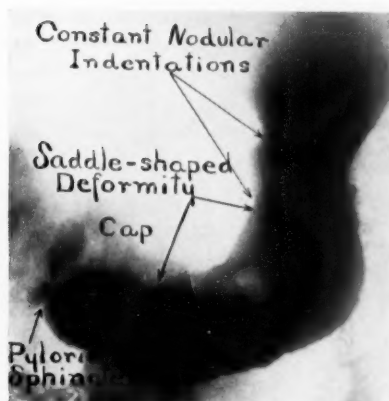


FIG. 3.—Clinical diagnosis: Gastric cancer. Röntgenologic diagnosis: Extensive carcinoma, involving entire lesser curvature. Surgical findings: Extensive carcinoma, involving most of lesser curvature. Case III.



FIG. 4.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Normal stomach and cap. Surgical findings: Normal stomach and cap. Case IV.

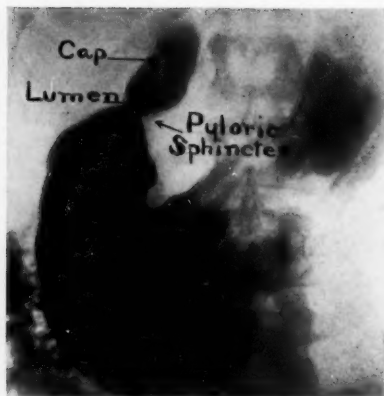


FIG. 5.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Normal stomach and cap. Surgical findings: Normal stomach and cap; diseased appendix. Case V.

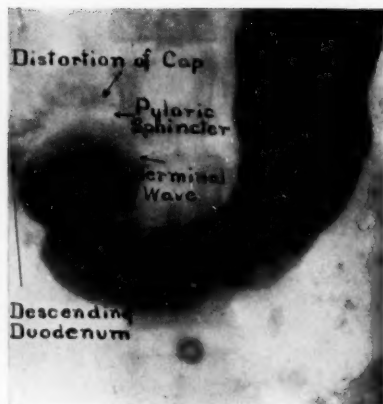


FIG. 6.—Clinical diagnosis: Gall-bladder infection. Röntgenologic diagnosis: Gall-bladder adhesions, involving the cap. Surgical findings: Gall-bladder adhesions involving the cap. Case VI.



FIG. 7.—Clinical diagnosis: Gastric carcinoma. Röntgenologic diagnosis: Carcinoma, involving pars pylorica, more extensive on the lesser curvature. Surgical findings: Carcinomatous induration involving the pylorus and extending along the lesser curvature. Case VII.



FIG. 8.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Lack of normal expansion and contraction of gastric walls, due to some functional disturbance. Case VIII.



FIG. 9.—Clinical diagnosis: Intestinal obstruction. Röntgenologic diagnosis: Gall-bladder infection with a calculus, causing adhesions involving pars pylorica. Surgical findings: Gall-stone obstructing upper part of jejunum, cholecystitis. Case IX.

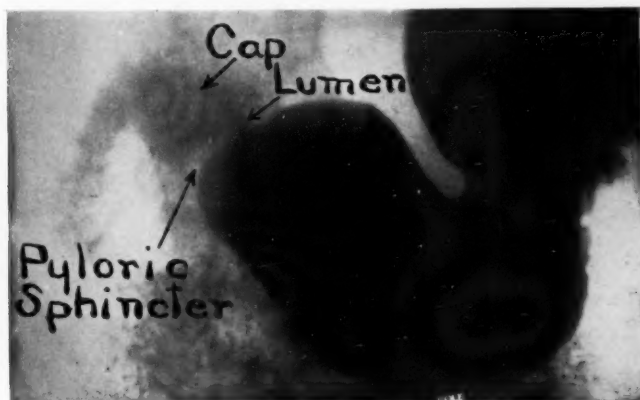


FIG. 10.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Spasm of cap and pars pylorica. No organic lesion of stomach or cap. Surgical findings: Normal stomach and duodenum. Case X.



FIG. 11.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Ulcer of the cap. Surgical findings: Ulcer of the cap. Case XI.



FIG. 12.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Ulcer of the cap, with adhesions involving the pyloric sphincter and lesser curvature of pars pylorica. Surgical findings: Ulcer of the cap with dense induration extending for a short distance along lesser curvature of stomach. Case XII.

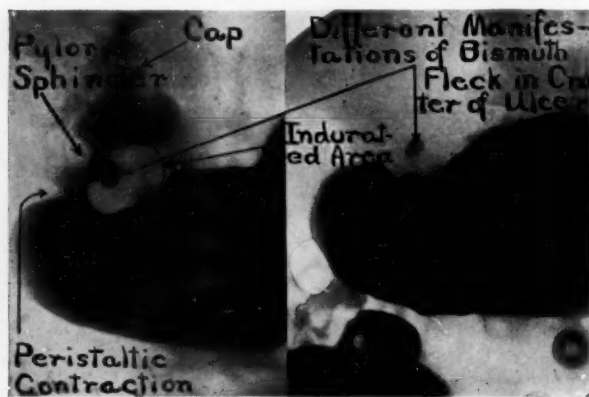


FIG. 13.—Clinical diagnosis: Gastric or duodenal ulcer. Röntgenologic diagnosis: Ulcer of the gastric side of the pyloric sphincter, most of the induration involving the stomach on the lesser curvature, although the cap also is encroached upon. Surgical findings: Induration of the cap near the pylorus, with slight thickening along lesser curvature of stomach for three-fourths of an inch. Case XIII.



FIG. 14.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: No evidence of gastric or duodenal lesion. Surgical findings: Normal stomach and cap. Case XIV.



FIG. 15.—Clinical diagnosis: Ulcer of cap or stomach. Röntgenologic diagnosis: Minute ulcer, with induration involving cap, pyloric sphincter and lesser curvature of pars pylorica. Surgical findings: Small, shot-like induration on duodenal side of pylorus. Case XV.



FIG. 16.—Clinical diagnosis: Definite ulcer of the cap. Röntgenologic diagnosis: Normal stomach and cap. Surgical findings: Normal stomach and cap. Case XVI.



FIG. 17.—Clinical diagnosis: Definite ulcer of the cap. Röntgenologic diagnosis: Obstruction at duodenojejunal junction. Displacement upwards of transverse colon by tumor mass. Surgical findings: Obstruction at duodenojejunal junction by enlarged tuberculous retroperitoneal glands. Case XVII.



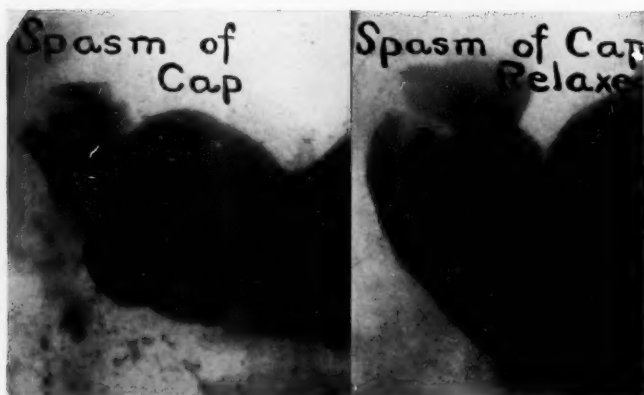


FIG. 18.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Spasmodic constriction of the cap. Surgical findings: Normal stomach and cap; diseased appendix. Case XVIII.

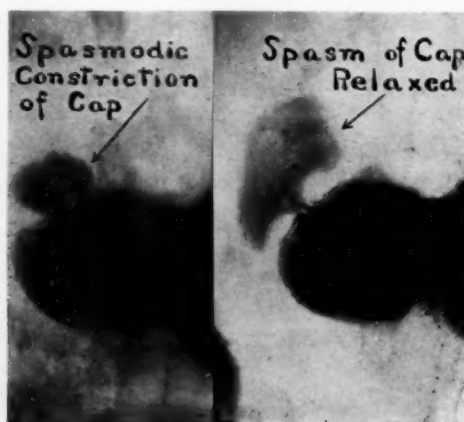


FIG. 19.—Clinical diagnosis: Perforated gastric ulcer. Röntgenologic diagnosis: Spasmodic constriction of cap, caused by acute angulation in first portion of transverse colon. No organic lesion of stomach or cap. Surgical findings: Normal stomach and cap. Adhesions of ascending colon. Case XIX.



FIG. 20.—Clinical diagnosis: Gastric ulcer four inches from pylorus. Röntgenologic diagnosis: Ulcer of the cap. Surgical findings: Ulcer of the cap. Case XX.



FIG. 21.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Ulcer of the cap. Surgical findings: Normal stomach and cap; diseased appendix. Case XXI.

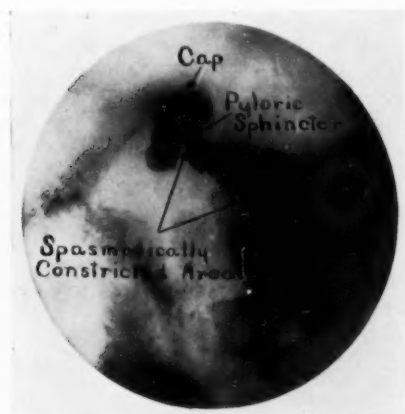


FIG. 22.—Clinical diagnosis: Ulcer of stomach or cap. Röntgenologic diagnosis: Annular lesion of pars pylorica. Surgical findings: Normal stomach and cap. Case XXII.



FIG. 23.—Another manifestation of spasm of pars pylorica, which presented in Case XXII.

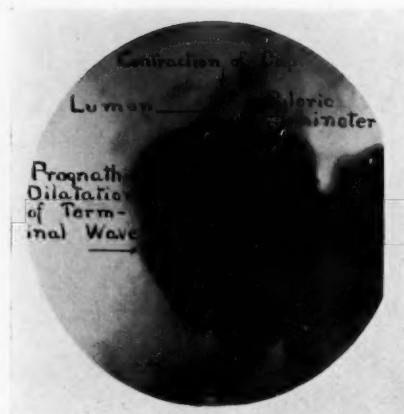


FIG. 24.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Ulcer of the cap. Surgical findings: Ulcer of the cap. Case XXIII.



FIG. 25.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Ulcer of the cap. Surgical findings: Ulcer of the cap. Case XXIV.

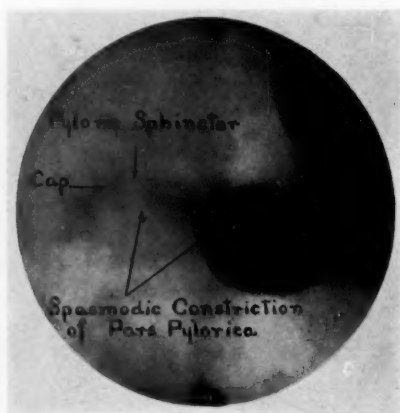


FIG. 26.—Clinical diagnosis: Gastric or duodenal lesion. Röntgenologic diagnosis: Spasmotic constriction of cap and pars pylorica. Surgical findings: Normal stomach and duodenum. Case XXV.



FIG. 27.—Clinical diagnosis: Ulcer of the cap. Röntgenologic diagnosis: Functional derangement of gastric digestion; no organic lesion of stomach or cap. Surgical findings: Normal stomach and cap. Case XXVI.

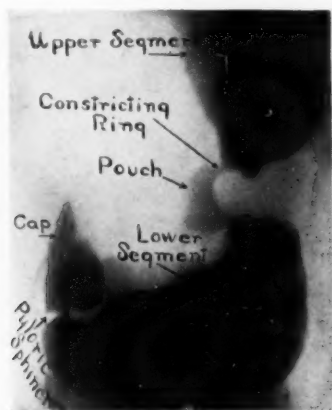
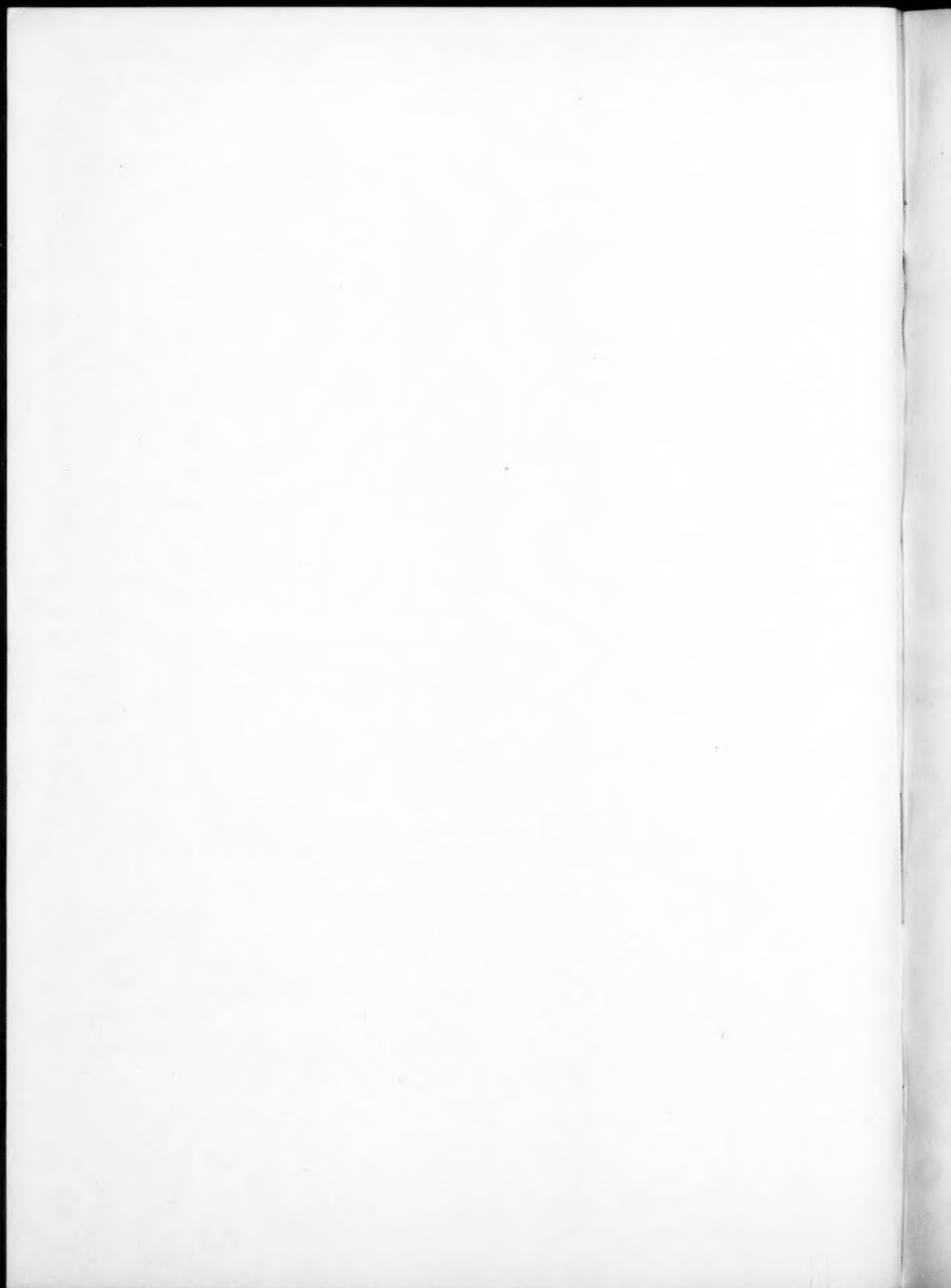


FIG. 28.—Clinical diagnosis: Gastric lesion of three months' duration. Röntgenologic diagnosis: Hour-glass stomach. Surgical findings: Hour-glass stomach. Case XXVII.





## RÖNTGEN DIAGNOSIS OF LESIONS OF STOMACH

pyloruswards. The wealth of detail obtained when the bismuth is suspended in buttermilk enables one to differentiate many non-malignant lesions from indurated gastric ulcer or carcinoma. Theoretically the method of interpreting röntgenographic findings is much the same as that employed by the pathologist in making a diagnosis from a pathologic specimen. All of the evidence assembled is utilized in making deductions, no single phenomenon being accepted as conclusive proof of a condition.

The interpretation of the röntgenograms and the diagnosis of the 27 consecutive cases described in this communication are the result of a study of about 20,000 röntgenograms of 700 cases. The 27 cases reported herein include all cases examined röntgenographically by Dr. Cole and subsequently operated upon by Dr. Brewer. Each case was referred to Dr. Cole with the simple statement that an organic lesion of the stomach or duodenum was suspected; no history or data obtained by physical examination or gastric analysis being furnished. As a result of the röntgenographic examination, a typewritten report was returned, giving the exact findings and an opinion regarding the presence or absence of a gastric or duodenal lesion, its location, extent and probable cause. In several cases a lesion of some other portion of the gastro-intestinal tract was diagnosticated. Later each case was explored, and the findings at operation were recorded.

The röntgenologic report on the first three cases will be given in full to indicate the method employed and the reasons for the final diagnosis. In the other cases only the final conclusions will be quoted. The full reports are on file in Dr. Cole's library and in the hospital records.

CASE I.—*Clinical History*.—C. H. P.; man; chronic dyspepsia for ten years. Began with pain after meals, belching of gas, and occasional sour eructations. Always worse after severe nervous strain. Some relief from medical treatment. Present condition: well nourished, active man. Complains of pain of a heavy, burning character one to three hours after meals. Often relieved by food or vomiting. History of occasional attacks of pain in right iliac fossa. Gastric analysis showed marked hyperacidity.

*Röntgenographic Findings*.—Three röntgenograms of the gall-bladder region show the ribs, spine, transverse processes and kidney distinctly. There is no evidence of any shadow which could possibly be interpreted as a gall-stone, but one is not justified in making a negative diagnosis of this condition solely from the röntgenographic findings.

A series of röntgenograms of the stomach, made with the patient in both the prone and erect postures, and in the anterior and posterior directions, shows its size, shape and position distinctly.

Type: Text-book.

Size: Dilated.

Position: Slightly prolapsed.

Peristalsis: 3 cycle type, equal on the greater and lesser curvatures, and unobstructed, except possibly at the extreme pyloric end of the stomach.

Systole and diastole: Shown distinctly.

Jejunum: Shown distinctly.

Duodenum (descending and horizontal portions): Shown distinctly.

Cap (first portion of the duodenum): Contracted in all the röntgenograms, and fails to have the clear-cut, well-defined edges of a normal cap.

Pyloric sphincter: Distorted by the contraction of the cap, especially on its duodenal surface.

The extreme pyloric end of the stomach on the lesser curvature presents a cup-shaped depression, which may be due either to a slight involvement by adhesions, or to a pressure from without.

A plate made 6 hours after the ingestion of bismuth, and after the patient had eaten a chop, baked potato and bread, shows considerable retention of food in the stomach. The outer side of the cap shows more distinctly than the inner, indicating that the lesion is on the left side of the cap.

*Röntgenologic Diagnosis.*—From a study of these plates, I believe we are justified in making a negative diagnosis of new growth of the stomach. There is, however, a definite lesion involving the cap. This does not have any of the röntgenographic evidence of malignancy, and I believe that it is due to a cicatricial contraction either from a duodenal ulcer or from gall-bladder infection. The weight of the evidence is strongly in favor of a duodenal ulcer on the lesser curvature side of the cap. Considering the definite lesion of the cap, and the moderate dilatation of the stomach and the retention of food after six hours, I believe that surgical procedure is indicated regardless of the symptoms.

*Surgical Findings.*—The stomach was normal. In the duodenal wall, one-half inch from the pylorus, was an oval indurated nodule, about 2 cm. in diameter.

A posterior gastro-enterostomy was performed.

A chronically thickened appendix was also removed through a second incision.

*CASE II.—Clinical History.*—O. H.; man; thirty-two years old. Chronic indigestion for seven years. Pain, sense of weight, nausea, and sour eructations after meals, often relieved by vomiting. Would often induce vomiting to relieve pain. Has lost flesh and strength through lack of food. No relief from eating. In hospital complained of severe pain after solid food. Gastric analysis showed hyperacidity. Wassermann test: 4 plus.

*Röntgenographic Findings.*—Röntgenograms focussed over the gall-bladder region show no evidence of any shadow which could possibly be

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interpreted as a gall-stone, but one is not justified in making a negative diagnosis of such a condition solely from the röntgenographic findings.

A series of röntgenograms of the stomach, made immediately after, and two, seven and one-half, and twenty-three hours after the ingestion of bismuth, shows the size, shape and position of the stomach, and the progress of the food through the tract.

Type of stomach: Deformed.

Size: Normal.

Position: Normal.

Peristalsis: 3 cycle type, obstructed on both greater and lesser curvatures in region of pars pylorica.

Systole and diastole: Shown distinctly.

Jejunum: Shown distinctly.

Duodenum (descending and horizontal): Shown distinctly.

Cap (first portion of duodenum): Contracted on left side.

The entire pars pylorica, and part of the pars media fail to expand and contract in a normal manner. Although the food begins to pass out of the stomach at an early stage after ingestion, there is considerable gastric retention seven and one-half hours later. In these röntgenograms the head of the bismuth column is at the hepatic flexure. The terminal portion of the ileum is considerably dilated.

*Röntgenologic Diagnosis.*—The findings indicate the presence of a primary gastric ulcer, the crater of which lies about 3 inches from the pyloric sphincter. Extensive induration surrounds the ulcer and extends along the greater and lesser curvatures of the pars pylorica, which shows annular constriction. Two torsive folds extend up along the gastric wall. The cap also is involved in adhesions. Whether or not any of the induration surrounding the ulcer has begun to undergo carcinomatous changes as yet, can be determined only by microscopic examination after its removal.

*Surgical Findings.*—A massive induration occupied the pyloric extremity of the stomach and extended from the lesser to the greater curvature, chiefly on the posterior surface. This was adherent to the transverse mesocolon, which was so infiltrated as to preclude the possibility of a posterior gastro-enterostomy. A number of enlarged lymph-nodes were present along the greater curvature, two of which were removed for microscopic examination.

An anterior gastro-enterostomy was done by the suture method.

*Pathologist's Report.*—The enlarged lymph-nodes showed no malignancy, only inflammatory hyperplasia.

Diagnosis: Chronic ulcer of the stomach with extensive gummatous infiltration.

CASE III.—*Clinical History.*—W. H.; man; age thirty-nine. Three months before admission began to have food distress with sharp pain radiating to left side of chest, sour eructations, and constant hunger. Food often relieves the pain. There is no loss

of weight or strength. Physical examination revealed movable tumor in epigastrium.

Gastric analysis: No free HCl or lactic acid. Trace of blood. Hæmoglobin, 59 per cent.

*Röntgenographic Findings.*—A series of röntgenograms of the stomach, made immediately and three hours after the ingestion of bismuth, shows the size, shape and position of the stomach distinctly.

Type: Deformed.

Size: Normal.

Position: Normal.

Peristalsis: 2 cycle type. Obscured along the entire lesser curvature.

Jejunum: Shown distinctly.

Duodenum (second and third portions): Shown distinctly, is symmetrical, corresponding in contour with the pyloric end of the stomach; separated from the pars pylorica by a space of about  $\frac{1}{8}$  inch, indicating the pyloric sphincter, both surfaces of which are clear-cut, and the lumen of which is centrally located.

There is no evidence of peristalsis on the lesser curvature, and its contour from the cardia to within  $1\frac{1}{2}$  inches of the pylorus is absolutely constant in all the röntgenograms. The involvement extends down along both the anterior and posterior walls of the stomach.

*Röntgenologic Diagnosis.*—The röntgenologic evidence in this case indicates an extensive new growth involving the entire lesser curvature in much the same manner as a saddle-shaped ulcer. Considering its great extent, and the constant nodular indentations, presenting the finger-print appearance, I believe we are justified in making a diagnosis of carcinoma too extensive for reasonable hope of removal.

*Surgical Findings.*—An extensive saddle-shaped carcinoma involved most of the lesser curvature, and extended downward on both anterior and posterior surfaces. There was no definite induration at the pyloric ring.

A partial gastrectomy was performed.

CASE IV.—*Clinical History.*—O. V.; woman; age thirty-three. Early history of appendix infection followed by appendectomy seven years ago. Complains of epigastric pain four hours after meals. Sour eructations and frequent vomiting of sour material with relief of pain. Has lost weight and strength. No jaundice. Physical examination negative, except for epigastric tenderness.

Gastric analysis: Free HCl, 30. Total, 60. Blood present in small amount.

*Röntgenographic Diagnosis.*—There is no evidence of new growth, indurated ulcer or adhesions involving the stomach or cap, and therefore no röntgenologic indication for surgical procedure on the stomach or duodenum.



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*Surgical Findings.*—The stomach and duodenum were normal. A chronically thickened and adherent gall-bladder was found, containing two large stones.

A cholecystectomy was performed.

*CASE V.—Clinical History.*—Mrs. H.; age forty. Patient has a history of having had several acute attacks of abdominal pain and fever, followed by soreness in the lower abdomen. One of these attacks had been diagnosticated as acute appendicitis by a competent physician, who advised operation in the interval. Subsequently she had suffered from digestive distress with more or less epigastric pain, gas, and sour eructations after meals. These symptoms would occur at variable intervals, last two or three weeks, and then disappear. On examination there was tenderness over the right hypochondriac and epigastric regions. Also tenderness at McBurney's point.

*Röntgenologic Diagnosis.*—There is no evidence of adhesions or new growth involving the stomach or cap. The first bismuth which passed out of the stomach proceeded rapidly through the jejunum and upper part of the ileum into the ascending and transverse colon. The food then ceased to pass through the second and third portions of the duodenum, although a large amount of bismuth still remained in the stomach and cap. The fact that the pylorus was open indicates that there was no obstruction to account for this retention at the pyloric sphincter.

*Surgical Findings.*—The stomach, duodenum, and gall-bladder were normal. A chronically diseased appendix was removed through a second incision.

*CASE VI.—Clinical History.*—Mrs. B.; age forty-four. Appendix removed several years ago. For past two years patient has complained of more or less constant epigastric distress after meals, with occasional vomiting of sour material. At frequent intervals this distress would become accentuated, and associated with severe pain over the region of the gall-bladder. While the symptoms were rather indefinite, the patient had lost much weight and strength and found it difficult or impossible to attend to her household duties. Physical examination revealed a generalized tenderness over the entire epigastric region, and well-marked Murphy's sign.

*Röntgenologic Diagnosis.*—The röntgenographic examination revealed only a slight distortion of the cap, probably due to an adhesion of the gall-bladder.

*Surgical Findings.*—There was a small band of inflammatory adhesion at the summit of the gall-bladder and adjacent liver border, extending to the junction of the first and second portions of the duodenum. This was divided.

*CASE VII.—Clinical History.*—E. S., woman. For the past



seven months this patient had suffered from a progressively increasing epigastric distress after eating, belching of gas, and of late, frequent vomiting. Record of physical examination, gastric analysis, and blood test have been lost.

*Röntgenologic Diagnosis.*—The extreme pyloric end of the stomach is constricted by an annular growth, more extensive on the lesser curvature than on the greater, and more extensive anteriorly than posteriorly. The weight of the evidence is in favor of the growth's being malignant. Immediate surgical procedure is indicated.

*Surgical Findings.*—A fairly extensive carcinomatous induration was found, involving the pylorus and extending along the lesser curvature half way to the œsophageal junction.

A partial gastrectomy was performed.

*CASE VIII.—Clinical History.*—N. H.; man. Seven years ago began to experience pain after eating, located in epigastrium, often relieved by food. Symptoms would occur in periods varying from 4 to 6 weeks at a time, followed by more or less complete relief for a longer or shorter period. Ever since onset of symptoms has had more or less dyspepsia with acid eructations. Occasional attacks of pain and discomfort over appendicular region without reference to the taking of food. At present, pain more pronounced three or four hours after mid-day meal.

*Röntgenologic Diagnosis.*—There is no evidence of new growth or indurated gastric ulcer. The irregular shape of the cap, the hazy edges of the sphincter, the lack of normal expansion and contraction of the pyloric end of the stomach, together with the appearance of the peristaltic contractions and the abnormal rugæ in this region, indicate that there is some lesion involving this portion of the stomach, probably adhesions, either from gall-bladder infection or from an ulcer. No evidence of an indurated gastric ulcer can be detected, but the constant indentation in the left side of the cap may be a duodenal ulcer. The fact that the food passed readily out of the stomach during the early stage of digestion indicates that there is no pyloric obstruction. The stasis of food in the stomach six hours after its ingestion, however, would indicate that there was an obstruction; but this stasis is probably due to some functional disturbance of the stomach or duodenum, rather than to an organic obstruction of the pylorus.

*Excerpt from Dr. Cole's letter to Dr. Brewer:* "This case of Mr. H. is typical of a group of about 20 cases, which show evidence of a definite lesion involving the pyloric end of the stomach and the cap. I have never felt that I could advocate surgical procedure in any such instances, although I am exceedingly anxious to know what pathologic condition causes these röntgenographic findings."

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*Surgical Findings.*—The stomach and duodenum were normal. No evidence of cholelithiasis or inflammation of the gall-bladder could be found. The appendix was removed. It was thickened, presented an obliterating stricture in its distal third, and was distended at the tip.

*CASE IX.—Clinical History.*—L. R.; woman. Patient was first seen by the writer during an attack of incomplete intestinal obstruction. Prior to the occurrence of these symptoms, she had suffered from dyspeptic symptoms for a number of years, associated with occasional attacks of severe epigastric pain. Shortly before the symptoms of obstruction appeared, two series of röntgenograms of the stomach and duodenum were made.

*Röntgenologic Diagnosis.*—The shadow in the gall-bladder region is a little too high for the normal position of the gall-bladder, but it certainly has the appearance of a rather large gall-stone. The absence of the duodenum, the contracted cap, the irregular and worm-eaten appearance of the pylorus, and the absence of the pyloric sphincter indicate a lesion in this region which calls for surgical procedure. This lesion is probably adhesions from gall-bladder infection with a calculus, but considering the irregular worm-eaten appearance of the pyloric end of the stomach, the possibility of carcinomatous degeneration cannot be eliminated.

*Surgical Findings.*—The upper part of the jejunum was distended. On following the distended bowel downward for about one meter, a hard oval mass was found, almost completely filling the lumen. Below this mass the bowel was collapsed. On opening the bowel, the obstruction mass was found to be an enormous oval gall-stone, measuring 3 cm. in its long diameter, and 2 cm. in its short diameter. The presence in the upper jejunum of a gall-stone of this size could be explained only by its sloughing through the walls of the gall-bladder and duodenum, creating the lesion described in the röntgenologic report.

*CASE X.—Clinical History.*—F. C.; woman. Entered the hospital for attacks of epigastric pain and sour vomiting. Appendix removed 18 months before admission. Since that operation has complained constantly of irritable stomach, irregular pains in epigastric, inguinal and umbilical regions, prostration, weakness, loss of flesh, and vomiting. Gastric analysis: Free HCl, 26; total acidity, 50; no lactic acid or blood.

The clinical picture was not characteristic of any definite lesion, but as the patient was practically bedridden, and constantly losing flesh, an exploratory operation was advised.

*Röntgenologic Diagnosis.*—There is no röntgenologic evidence of gastric carcinoma or indurated ulcer. The incomplete filling of the cap in the majority of the plates would make one extremely

suspicious of a duodenal ulcer, but as a practically normal cap presents in one or two of the röntgenograms, its constriction in the majority of the plates must be due to a spasmodic contraction, probably associated with a pylorospasm. There is a slight possibility that this pylorospasm is caused by a small duodenal ulcer on the lesser curvature of the cap, but there is not sufficient evidence to justify one in coming to such a conclusion.

*Surgical Findings.*—The stomach and duodenum as well as the gall-bladder, pancreas and colon were normal.

CASE XI.—*Clinical History.*—J. McG.; man. Three years ago began to have epigastric pain after meals, generally relieved by food and occasionally by belching. Freedom from symptoms for periods of variable duration. Occasional attacks of sudden weakness with marked pallor. Did not notice color of stools. All symptoms relieved when on a purely milk diet, but would return on resuming solid food. Gastric analysis: Free HCl, 80; total, 105; no lactic acid or blood.

*Röntgenologic Diagnosis.*—Röntgenograms of the stomach show no evidence of new growth or indurated ulcer. The absence of the cap justifies a suspicion of some lesion involving this portion of the duodenum, possibly a duodenal ulcer. But the fact that the chyme passes rapidly out of the stomach into the second and third portions of the duodenum, jejunum, and even down into the ileum, indicates that there is little or no obstruction to the evacuation from the stomach of fluid contents. Unfortunately four- and six-hour plates, to determine how completely the stomach emptied itself, were not made.

*Surgical Findings.*—The stomach was somewhat dilated. A moderate-sized induration was found in the first part of the duodenum, one-half inch from the pylorus. The peritoneal surface of the duodenum was puckered and scarred over the surface of the induration. A posterior gastro-enterostomy was performed.

CASE XII.—*Clinical History.*—T. M.; man. Suffered for two years from pain two or three hours after meals, relieved by vomiting or taking more food. Often induces vomiting to relieve pain. Of late has had copious vomiting once every three or four days. No blood in vomitus. Stools often black in color. Loss of forty pounds in weight. Gastric analysis: Free HCl, 40; total, 60; no lactic acid or blood.

*Röntgenologic Diagnosis.*—There is an obstruction of the cap, causing an immense dilatation of the stomach. This is caused by an ulcer on the anterior surface of the cap. Surrounding adhesions involve the pyloric sphincter, and possibly also extend on to the stomach.

*Surgical Findings.*—There was a dense indurated area in the

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first part of the duodenum, extending for a short distance along the lesser curvature.

A gastro-enterostomy was performed.

CASE XIII.—*Clinical History*.—P. O'B.; man. For 5 years patient has suffered from a gnawing pain in the epigastrium, coming on 2 or 3 hours after eating, and continuing until relieved by next meal. There are frequent eructations of gas during period of pain, and occasionally a small amount of sour irritating fluid rises in the throat. Stools often black in color. Has vomited only twice. No blood seen in vomitus. Has not lost weight or strength.

*Röntgenologic Diagnosis*.—A definite lesion involves the extreme pyloric end of the lesser curvature of the stomach, causing an anterior retraction of the cap. This corresponds with an ulcer of the cap, but röntgenographic findings indicate that most of the induration involves the stomach, rather than the cap, although the lesion may have started in the postpyloric surface of the sphincter. There is no evidence of obstruction. The bismuth filled crater and the everted edges of the ulcer, viewed in profile, are classical. Whether or not there are any carcinomatous changes at the base of this ulcer, can be determined only by a microscopic examination.

*Surgical Findings*.—A duodenal induration was found near the pylorus, with slight thickening along the lesser curvature for a distance of  $\frac{3}{4}$  inch.

A gastro-enterostomy was performed.

CASE XIV.—*Clinical History*.—Since first child was born 22 months ago, patient has suffered almost constantly with dull epigastric pain, which has no relation to eating. Pain radiates over whole abdomen, but is marked in upper right quadrant, and frequently passes through to back and up to shoulder. Causes vomiting when severe. Vomitus bitter, with dark red streaks like blood on two or three occasions. Bowels constipated. Stools very dark. No urinary symptoms. Has never been jaundiced. Has lost about 40 pounds in 3 years.

*Röntgenologic Diagnosis*.—The röntgenographic findings justify a negative diagnosis of new growth of the stomach, except possibly at a minute area near the pylorus. The incomplete filling of the cap, the abnormal pyloric sphincter, and the constant indentation on the lesser curvature of the extreme pyloric end of the stomach, are the most important röntgenographic findings, and indicate some lesion at this point. Considering the incompleteness of examination, one is not justified in stating with certainty whether there is an ulcer of the cap or adhesions from some other cause.

*Surgical Findings*.—The stomach, duodenum, and gall-bladder were normal. A chronic appendix was removed.

CASE XV.—*Clinical History*.—J. A.; man. About 6 months



ago developed dull, "grinding" pain in epigastrium about 1 hour after meals, lasting from 10 to 20 minutes; never very severe. Does not radiate up or down, is relieved by medication, belching or taking food, and has never caused vomiting. Symptoms disappear on rigid dieting, but return when regular diet is resumed. Stools not tarry in color; bowels regular; no urinary disturbance.

*Röntgenologic Diagnosis.*—The röntgenographic findings present no evidence of gastric carcinoma. The increased width of the pyloric sphincter on the lesser curvature side of the lumen, and the irregularity of the extreme pyloric end of the stomach and the left side of the cap, indicate that there is a minute lesion involving the cap, sphincter, and the extreme pyloric end of the stomach. The entire involvement, including induration and adhesions, is less than half an inch in diameter, and causes absolutely no interference with the evacuation of the stomach. In fact, it probably acts as an irritant, causing the stomach to evacuate itself with more than normal rapidity. This is by far the smallest lesion that I have been able to recognize by this method of examination. It corresponds with Codman's pathologic description of a healed ulcer, or my own conception of an extremely early ulcer.

*Surgical Findings.*—A small, shot-like induration was discovered on the duodenal side of the pylorus. The stomach was normal.

A gastro-enterostomy was performed.

CASE XVI.—*Clinical History.*—R. R.; woman. For the past six months, patient has suffered from abdominal pain, chiefly located in right iliac fossa, aggravated by taking solid food. Pain increases about half an hour after meals. Some nausea. No vomiting. Is much troubled by belching of gas and sour eructations. Has lost 20 pounds.

Gastric analysis: Free HCl, 29; total, 51; no lactic acid or blood.

*Röntgenologic Diagnosis.*—The röntgenographic findings justify a negative diagnosis of new growth or indurated ulcer of the stomach or cap. The localized collection of bismuth in a coil of the intestine, in the position of the third portion of the duodenum, is a very constant finding in all the röntgenograms. This is probably due to a kink at this point with partial obstruction, but it is difficult to conceive of such a kink in this region. There is no röntgenographic indication for surgical procedure upon the stomach or cap, but if the symptoms correspond with the localized accumulation of bismuth above described, the plates could then be used as strong corroborative evidence for operative procedure.

*Surgical Findings.*—No lesion of stomach, duodenum or gall-bladder was found. Upper portion of jejunum was examined and found to be normal. Chronically diseased appendix was removed.



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CASE XVII.—*Clinical History*.—S. S.; man. Three years ago patient began to notice epigastric pain coming on directly after meals, lasting one to two hours, disappearing spontaneously, leaving him free until the next meal. Induced vomiting at times to relieve pain when very severe. Much troubled by belching and sour eructations during period of pain. Loss of 20 pounds, feels weak and miserable. Gastric analysis: Free HCl, 20; total, 40; no lactic acid or blood.

*Röntgenologic Diagnosis*.—There is no evidence of new growth or indurated ulcer of the stomach or duodenum. The immense dilatation of a section of the small intestine in the region of the descending and horizontal duodenum indicates that there is a chronic obstruction of the small intestine, probably at the duodenojejunal junction. The displacement of the first portion of transverse colon over a dome-shaped area is suggestive of tumor, possibly at the head of the pancreas. The röntgenologic evidence indicates surgical procedure in region of the duodenojejunal junction.

*Surgical Findings*.—The stomach and first part of the duodenum were normal. At the duodenojejunal junction was a large, hard, nodular mass behind the parietal peritoneum, surrounding the aorta, adherent to and causing pressure on the first portion of the jejunum. There was also a congenital anomaly of the mesentery, resulting in a large hole or pocket, through which a considerable length of the small intestine passed without constriction. Numerous other enlarged retroperitoneal nodes were found along the root of the mesentery. The condition was diagnosed as probably tuberculosis of the retroperitoneal lymph-nodes. The adhesions between the large glandular mass and the jejunum were separated, relieving the intestinal stenosis.

CASE XVIII.—*Clinical History*.—M. C.; man. For past eighteen months patient has suffered with severe general abdominal pain, coming on immediately after meals, and lasting an hour or two. Belches gas almost continuously. Has never vomited. Bowels regular; has small watery stool three times a day, usually after eating. Several times has noticed blood in stool, last time three months ago. Has lost about 15 pounds in 18 months. Gastric analysis: Free HCl, 20; total, 30; small amount of blood.

*Röntgenologic Diagnosis*.—There is no röntgenologic evidence of new growth or indurated ulcer of the stomach. The constant irregularity of the cap in all the plates of the prone position, and the irregularity of the pyloric sphincter with the patient in the erect posture indicates that there is a lesion at this point. But considering the symmetry of the cap in a few of the röntgenograms of the erect posture, the lesion should be regarded as spasmodic rather than organic. The cause of the spasm may be

found at the appendix or at some distant point. There is no röntgenologic indication for surgical procedure at pyloric sphincter.

*Surgical Findings.*—No lesion of the stomach or duodenum was discovered. The appendix was thickened, angulated and imbedded in adhesions.

CASE XIX.—*Clinical History.*—C. S.; man. Admitted to the hospital with a diagnosis of perforated gastric ulcer. Acute epigastric pain, severe and protracted vomiting. Vomitus contains blood. Exquisite tenderness and muscular rigidity in epigastric and right hypochondriac regions. Moderate fever. Blood count, 22,000; polynuclears, 80 per cent. As symptoms were atypical, no operation was advised, and patient was kept under observation for three or four days. At end of that period, all signs of peritoneal irritation having subsided, a series of röntgenograms was made to see if any gastric or duodenal lesion could be demonstrated.

*Röntgenologic Diagnosis.*—There is no evidence of new growth, indurated ulcer or adhesions of the stomach or duodenum. The acute angulation in the first portion of the transverse colon, if permanent, might possibly cause the symptoms of which this patient complains. It is doubtful if the dilatation in the terminal portion of the ileum is of any pathologic significance.

*Surgical Findings.*—The stomach, duodenum and gall-bladder were normal. There was a definite band of adhesions on the ascending colon, causing angulation. The adhesions were divided.

CASE XX.—*Clinical History.*—Mrs. H., age sixty-seven. Indigestion since childhood. Eight years ago epigastric distress, occurring regularly 3 to 5 hours after meals, relieved by alkalines or more food. Sour eructations, gas and loss of weight. Increase of symptoms 5 years ago with hæmatemesis. In bed for several weeks. Leube cure. Gastric analysis at that time: Free HCl, 60; total, 104. Occult blood in stools. String test on 2 occasions showed stain, indicating gastric ulcer near cardia.

*Röntgenologic Diagnosis.*—There is no röntgenologic evidence of new growth or ulcer of the stomach. Extensive adhesions, probably from an old ulcer or gall-bladder infection, involve the cap. It is evidently adherent to the liver. The stasis of food in the stomach 6 hours after ingestion corroborates this diagnosis.

*Surgical Findings.*—The stomach was moderately dilated. In the first portion of the duodenum was a large indurated mass,  $\frac{3}{4}$  inch in diameter, with extensive adhesions to the surrounding parts. A posterior gastro-enterostomy was performed.

CASE XXI.—*Clinical History.*—M. O.; man. Two and one-half years ago, having been perfectly well previously, the patient began to suffer from dull aching pain in the right lower quadrant, coming on about two hours after meals, accompanied by nausea, but no vomiting. The pain generally passes off in about half an

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hour, and is relieved by taking food. Eating meat, or any heavy food makes the pain much worse, and such articles of food have been removed from his diet for some time. Has no acid eructations. Bowels are rather constipated, though fairly regular. Has never noticed blood in movements or tarry stools. Loss of 54 pounds in last two years, though he feels fairly strong. Gastric analysis: Free HCl, 51; total, 39; no lactic acid or blood.

*Röntgenologic Diagnosis.*—There is very strong evidence of an ulcer of the cap. The site of the ulcer is evidently about  $\frac{1}{4}$  inch distant from the pyloric sphincter.

*Surgical Findings.*—No lesion of the stomach or duodenum was discovered. A chronically diseased appendix, containing a concretion near the tip, was removed.

NOTE.—Case XXI is one of the two cases in which a definite röntgenologic diagnosis was disproven by surgical procedure. The diagnosis of ulcer of the cap was based on too few röntgenograms to justify a differentiation between ulcer and spasmodic contraction. The hyperæmia and œdema, observed at operation, were undoubtedly the result of a spasm, but no ulcer was found.

CASE XXII.—*Clinical History.*—W. W.; man. Seven years ago had distress in the stomach after eating, and vomited frequently. Occasionally vomitus contained blood. Troubled also with acid eructations. Symptoms continued for four years. Since that time has had a vague soreness over the upper abdomen with gas and occasional vomiting.

*Röntgenologic Diagnosis.*—An annular lesion involves the extreme pyloric end of the lesser curvature. The growth lacks the characteristic indentations of the "finger-print" appearance of a carcinoma, but it should be considered malignant until proven otherwise by microscopic examination.

*Surgical Findings.*—No lesion of the stomach, duodenum or gall-bladder was found. The appendix was removed.

NOTE.—Case XXII is the second of the two cases in which surgical procedure proved that the röntgenologic diagnosis was not correct. The röntgenologic findings had all of the characteristics previously described as indicating spasm, but as the area involved was accentuated by a circular constriction, the lesion was considered organic rather than spasmodic. A careful matching of the röntgenograms over each other would have prevented this mistake.

CASE XXIII.—*Clinical History.*—H. P.; man. Syphilis twelve years ago. Heavy drinker until seven months ago. Chronic dyspepsia for years, pain after meals, sour eructations, vomiting and soreness in epigastrium. Of late loss of weight (50 pounds). Vomiting of large quantities of foul undigested food. Gastric analysis: Free HCl, 38; total, 50.

*Röntgenologic Diagnosis.*—There is no evidence of new growth involving the stomach itself. An obstruction presents at the pylorus, involving either the first portion of the duodenum or the pyloric sphincter, or both. The lesion probably is due to a duodenal ulcer, either old or new. Considering the immense pro-nathian dilatation of the stomach, and the retention of food, there is no question but that surgical procedure is definitely indicated.

*Surgical Findings.*—The stomach was enormously dilated. A hard indurated mass, one-half inch in diameter, extended on to first portion of duodenum. A gastro-enterostomy was performed.

CASE XXIV.—*Clinical History.*—M. M.; woman. Indigestion since childhood after tiring work. Occasional sharp attacks of colic in upper abdomen of late. Epigastric distress, occurring after meals, about 11 A.M. and 5 P.M., and after retiring at night. Considerable loss of weight.

*Röntgenologic Diagnosis.*—There is no evidence of carcinoma or indurated ulcer of the stomach itself. The constant deformity of the cap, viz., the permanent indentation in the upper edge and the pouching of the lower portion, indicates a definite lesion in the upper portion, either from a duodenal ulcer or gall-bladder infection, with the weight of the evidence in favor of the former.

*Surgical Findings.*—The stomach was found to be normal. A small, shot-like induration presented on the posterior wall of the duodenum,  $\frac{1}{4}$  inch from the pylorus. A gastro-enterostomy was performed.

CASE XXV.—*Clinical History.*—J. P.; man; age forty. The patient had dysentery in 1899. Since 1905 has had chronic indigestion, hunger pains, occasional severe pain in epigastric area after eating, with more or less soreness in appendicular region.

*Röntgenologic Diagnosis.*—No evidence of new growth or indurated ulcer of the stomach or duodenum can be detected. The contraction of the cap and the extreme pyloric end of the stomach is probably due to a spasm or possibly to adhesions. The flattening of the left side of the ascending colon, the incomplete distention of the cæcum, the insufficiency of the ileocæcal valve, with the distended coils of small intestine pressing on the left side of the ascending colon up to the region of the gall-bladder, are sufficient to cause the spasm of the stomach and cap.

*Surgical Findings.*—The stomach and duodenum were normal. Two small adhesions passed from the summit of the gall-bladder and duodenum to the liver. An adherent, thickened and angulated appendix was removed.

CASE XXVI.—*Clinical History.*—N. R.; woman; age twenty. Six months ago the patient first began to complain of pain in epigastrium, coming on 2 or 3 hours after meals, gnawing in



## RÖNTGEN DIAGNOSIS OF LESIONS OF STOMACH

character and relieved by taking food or bicarbonate of soda. Three months later the pain began to be associated with attacks of vomiting, which relieved the pain. Vomitus consisted of food recently taken, and twice contained a little blood. Four months after onset of symptoms, patient entered hospital and was treated for 3 weeks with a diet. Diagnosis: Gastric ulcer. After leaving hospital, was free from pain until a week ago, when it returned with occasional vomiting. Loss of 16 pounds in last 6 months. Gastric analysis: Free HCl, 17; total, 36; no lactic acid or blood.

*Röntgenologic Diagnosis.*—The röntgenographic findings justify a negative diagnosis of new growth or indurated ulcer of the stomach or duodenum. That there is an extreme functional derangement of the stomach is evident from the erratic motor phenomena. When the food was first administered there was a great atony, and no evidence of peristalsis. A few minutes later the peristalsis became hyperactive, and the food was rapidly expelled through a wide open pylorus for a short time, and progressed at great speed through the cap, duodenum and into the jejunum. The  $2\frac{1}{2}$ -hour röntgenograms show that the stomach is perfectly normal in position, and the cap well distended. But there is no evidence of any food passing through the duodenum or jejunum. In the  $5\frac{1}{4}$  röntgenograms, a moderate gastric retention is seen, with no evidence of the pars pylorica, cap, duodenum, or jejunum. I am unable to determine the cause of this functional disturbance.

*Surgical Findings.*—The stomach, duodenum and gall-bladder were found to be normal. A thickened and congested appendix, containing a large amount of fecal matter, was removed.

*CASE XXVII.—Clinical History.*—S. B.; woman. For the past 3 weeks patient has complained of almost constant epigastric pain, eructations and nausea. On the day before admission she had an attack of severe pain, radiating to the side and back. The pain has no relation to eating and is relieved by vomiting, which occurs frequently. The vomitus is usually small in amount, greenish and occasionally blood streaked. The patient has never been jaundiced. She believes she has lost some weight. Gastric analysis: Free HCl, 0; total, 26; lactic acid, 0. Blood positive. Blood analysis: Hæmoglobin, 80 per cent.; red blood cells, 5,000,000; white blood cells, 12,000.

*Röntgenologic Diagnosis.*—There is evidence of an organic hour-glass constriction, with a pouching or perforated ulcer on the lesser curvature, or perhaps a double constriction. Personally, I have seen these lesions occur in unquestionable cases of carcinoma, and I am therefore not prepared to state that it is indicative of a non-malignant condition.



*Surgical Findings.*—On operation it was discovered that the entire central area of the stomach was distorted by a massive carcinomatous induration, extending from the lesser curvature to the greater, more marked on the posterior surface, in which situation the induration also extended to the pancreas. This resulted in an hour-glass contraction of the stomach, the upper segment of which was concealed beneath the costal border. The lower pouch lay in its normal position. It was impossible to do a gastro-enterostomy with the upper pouch on account of its high position. A gastrogastrostomy was therefore made on the anterior surface of the stomach by the suture method.

In summing up the evidence furnished by this series of 27 cases, it will be seen that of the 22 cases in which a definite diagnosis was made by the Röntgen method, subsequent operation proved that in 20 instances this diagnosis was correct, and in 2 it was incorrect. In 11 of these cases the diagnosis was a negative one regarding the presence of a gastric or duodenal lesion, although the clinical history so strongly suggested ulcer or carcinoma as to justify exploratory operation. In not one of these cases was an organic lesion found to exist. In the 5 instances in which the röntgenologic diagnosis was not definitely stated, owing to incomplete observation, or unusual findings which could not be definitely interpreted, and concerning which only an opinion was expressed as to the probable lesion present, the opinion proved to be correct in 4 instances and incorrect in one instance. In other words, in this particular series, a correct diagnosis was made by serial röntgenography in 89 per cent. of the cases. The information obtained from this series has been invaluable to the röntgenologist in his interpretation of unusual findings, and the experience gained from the hearty coöperation of the surgeon will greatly increase the accuracy of this method of examination.

The objections to the method are obvious. It requires considerable time and is moderately expensive. If it could be shown that a simpler method would give equally good results, that method would undoubtedly become the popular one. In the opinion of the writers, however, serial röntgenography will give more accurate information concerning lesions of the stomach and duodenum than any other method now employed.

## PERSISTENT EMBRYONAL TYPE OF LARGE INTESTINE \*

BY H. BEECKMAN DELATOUR, M.D.

OF BROOKLYN, NEW YORK

A KNOWLEDGE of embryology is necessary to a proper understanding of certain pathological conditions encountered during surgical operations. The possession of this knowledge before being confronted by these anomalies during an operation will be of great aid in determining the proper procedure to follow.

We have had presented to us on the operating table at various times certain anomalous positions of the intestine which, when studied, were found to be in fact persistent embryonal types. The following cases will illustrate:

**CASE I.**—A lady in middle life was seized with severe abdominal pains in the upper abdomen, with nausea and vomiting. After a few hours the pain and tenderness were confined to the right hypochondrium. The pulse and temperature as well as the blood count indicated a rather acute inflammation. There was no tenderness in the iliac region. A diagnosis of acute cholecystitis was made and operation advised.

**Operation.**—Right rectus incision in the upper abdomen. On opening the peritoneum there were the evidences of a local peritonitis, the intestine being covered with fresh lymph. On separating the recent adhesions between the liver and intestine we came on an acutely inflamed and gangrenous appendix. The appendix lay between the cæcum, situated at the site for the hepatic flexure and the liver, and passed upward, inward, and backward, being attached to the gall-bladder. The appendix was removed in the usual manner. The ileum joined the cæcum from below.

This is one of the more common forms of the embryonal type, as it is the last stage in the process of elongation and rotation of the large intestine. This is the position the cæcum should occupy about the fourth month of intra-uterine life. Smith, in his review of the position of the cæcum in infants, states that in 1050 autopsies on infants under three months he found the cæcum in this position 63 times.

In numerous cases of appendicitis in children we have found the appendix situated above the level of the umbilicus. This proves that in

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\* Read before the New York Surgical Society, October 28, 1914.

many the complete descent of the cæcum does not take place until after birth. While we cannot give accurate figures we have seen the cæcum and appendix in this position in a sufficiently large proportion of cases for us now to always place the incision in children at a higher level than in adults.

Nine examples of undescended cæcum in adults have come under our observation.

CASE II.—H. W. B., salesman, fifty years. Nothing in the early history bearing on the present condition. There was no history of stomach or intestinal disturbance.

Thirty hours before admission to the hospital, he was suddenly awakened with extreme abdominal pain, localized in the epigastrium and left hypochondriac region. There was no nausea, but the patient produced vomiting in the hope of getting relief. He was given some anodyne and heat applied. There was tenderness above and to the left of the umbilicus. That evening his condition seemed somewhat improved, and the tenderness less marked. In the morning there was more marked distention, and pain had increased. He was at once removed to the hospital. At the time of admission the pain had become general, and the tenderness most marked to the left of the umbilicus. There was considerable distention. Diagnosis: Probable duodenal or gastric ulcer.

*Operation.*—Forty hours after beginning of attack, an incision, four inches long, was made to the left of the median line with its lower end opposite the umbilicus. On opening the peritoneum there was an escape of purulent serum and the distended intestines were much injected. In the region of the stomach and duodenum, there was no evidence of lesion and the fluid came up from below. The incision was then extended downward and the ascending colon found to be to the left of the median line. On following this downward, we came to some recent adhesions between the cæcum and the descending colon. On breaking through these there was a discharge of foul-smelling pus and in the cavity formed between these portions of the bowel was found a completely gangrenous appendix. The appendix lay along the left side of the spine with the tip adherent to the left kidney. The appendix was ligated and removed. The patient took the anæsthetic badly and it was with much difficulty that the distended intestines were handled.

For twenty-four hours the progress was satisfactory, but, at the end of this time, distention began again and was accompanied by nausea, and a little later by vomiting of a greenish fluid. There was also a good deal of abdominal pain. Lavage gave very little

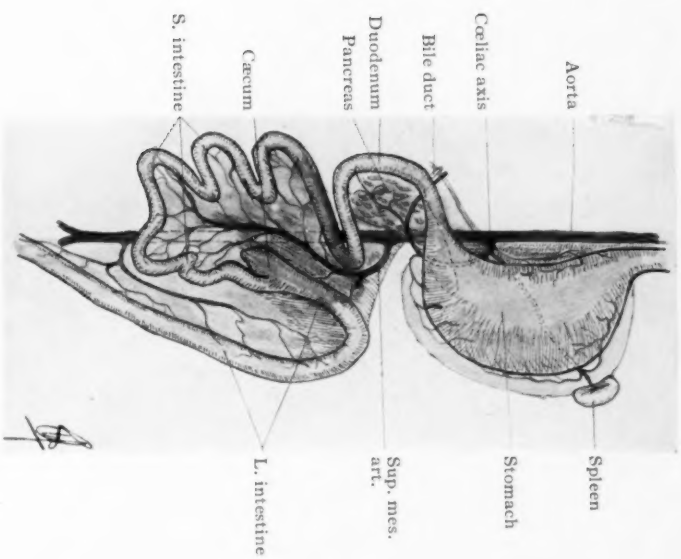


Fig. 1.—Diagram representing early stage of rotation of abdominal viscera (Deaver's *Surgery of the Upper Abdomen*).

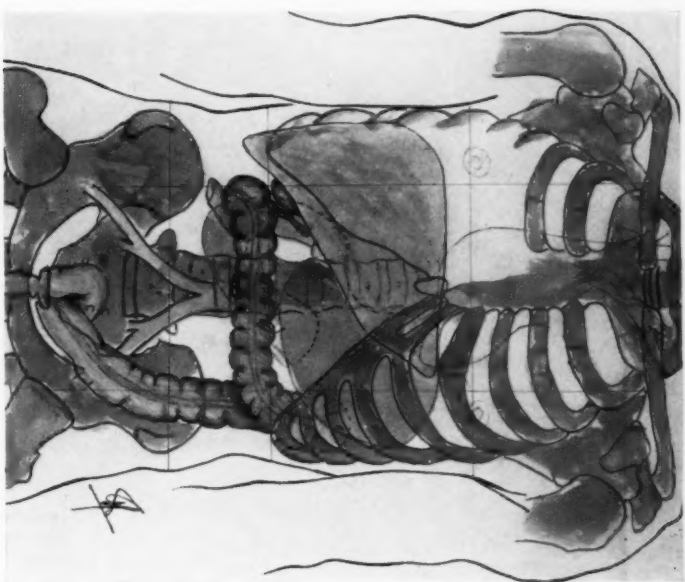


Fig. 2.—Case I. Partial rotation of large intestine.



FIG. 6.—Case III. Five minutes after bismuth meal. The stomach does not begin to empty in a normal manner; the appearance is that of pylorospasm. (Röntgenogram by Dr. L. T. Le Wald, at St. Luke's Hospital, New York.)



FIG. 7.—Case III. Thirty-three minutes after bismuth meal. Only enough of the meal has gone through the pylorus to outline the duodenal cap. This confirms the diagnosis of pylorospasm. (Röntgenogram by Dr. L. T. Le Wald.)

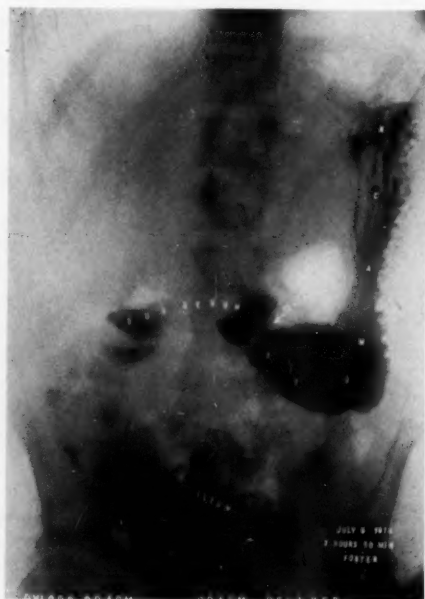


FIG. 8.—Case III. Two hours and fifty minutes after bismuth meal. The spasm has now relaxed and a large portion of the meal has been rapidly passed through the pylorus. Note the peculiar position of the duodenum; it passes almost straight out to the right and then curves downward; it is characteristic of the appearance of non-rotation of the colon. (Röntgenogram by Dr. L. T. Le Wald.)



FIG. 9.—Case III. Eight minutes after bismuth injection and about three hours after administration of bismuth meal. Note that the entire colon is practically to the left of the median line, showing the typical appearance of complete non-rotation of the colon. The jejunum and ileum appear to be almost all to the right of the median line. Note the position of the duodenum passing to the right instead of downward and behind the stomach. (Röntgenogram by Dr. L. T. Le Wald.)



### PERSISTENT EMBRYONAL TYPE OF LARGE INTESTINE

relief. Enema brought away considerable gas, and some fæces. There was considerable purulent, offensive drainage from the wound. The patient's condition gradually became worse, with all the evidences of a general septic peritonitis, and he died on the third day.

In this case there was a short transverse colon, with the ascending colon passing obliquely downward across the abdomen to the left, the cæcum being entirely to the left of the spine. This case and the following are examples of the position of the large bowel in the earlier months of fetal life.

CASE III.—F. H. F., 19 years. Until fourteen years of age was never a strong boy. Although generally constipated, he suffered at times prolonged attacks of diarrhœa. He always had more or less vague abdominal pains. Ten days before admission to the hospital, he suffered an attack of diarrhœa, with severe abdominal pains about the umbilicus. Two days ago the pains again became severe. On the day of admission the pains remained quite severe, there was fever, and tenderness immediately below the umbilicus, with marked rigidity of the left rectus. Blood examination; leucocytes, 11,400; polymorphonuclears, 70 per cent. A diagnosis of appendicitis, with appendix to the left, was made.

*Operation.*—An incision through the right rectus muscle was made, nearer the median line than usual. On opening the peritoneum, the first thing of note was the peculiar appearance of the small intestine and stomach, and the non-appearance of the large intestine. The right abdomen contained a mass of coils of small intestine, bound together by thin membrane, in places angulating the gut and in others producing a narrowing of the canal, almost to occlusion. In the upper angle of the wound could be seen the stomach with the duodenum, supplied with a mesentery, coming from it in almost a straight line. The usual curve at the pylorus was absent. No colon or omentum was to be seen. The hand was then passed to the left side of the abdomen and the cæcum found to be in the left iliac fossa, with ascending colon passing directly up and parallel to the descending colon. The cæcum was lifted up and with it the inflamed and thickened appendix. The appendix lay in the left iliac fossa. The appendix was removed.

Attention was next directed to the small intestine and many inches of the bands of adhesion, or veils, were divided in order that the bowel might be relieved of constrictions. The wound was then closed in layers without drainage.

The first forty-eight hours following operation presented nothing unusual, except for some hiccough. The patient was exceedingly anxious and apparently apprehensive. On the third day there was marked vomiting and considerable abdominal pain. The patient at times appeared to be irrational. The temperature on June 13, the second day after the operation, was 98° F., and the pulse 54. From then until June 19, the eighth day, the progress was very satisfactory. On the evening of this day trouble began with pain and vomiting of a quantity of undigested food. During the next four days vomiting became almost persistent and lavage gave only temporary relief. The patient was retaining no nourishment, the temperature became subnormal, the pulse rapid and feeble and the eyes sunken. There was complaint of griping pains, burning in the stomach, and constant hiccough and coughing. The bowels moved regularly and there never had been any distention. No reason could be discovered for these symptoms and as the boy was exceedingly neurotic, most of the symptoms were attributed to this. The boy, however, was losing ground.

The vomit was very acid and irritated the skin about the mouth, the urine was exceedingly acid and the odor about the bed was acid. At this time Dr. Duffield, who had been kindly attending the case for me, as I left for my vacation the day following the operation, came to the conclusion that the trouble might be one of the acidoses, and began the administration of milk of magnesia in two-drachm doses, every two hours. This was also used as a mouth wash. There was immediate improvement following this and after twenty-four hours no further vomiting. Improvement was rapid and at the end of the week he was able to be removed to a hotel. The case finally went on to complete recovery.

After leaving the hospital the patient was under the care of Doctor Donald Gordon, of Manhattan, who wrote me as follows:

I saw him three weeks after operation and on examination of abdomen, immediately after the ambulance trip, I could make out easily peristaltic waves moving from left to right midway between the ensiform and umbilicus. I should say they extended over a distance six inches broad, as if made by a large viscus. They were visible to his father and the nurse. He had an indefinable sensation accompanying these, which stopped when the waves ceased, though he did not know what I was observing. The waves could be stirred up by gentle massage of the upper abdomen.

The boy went rapidly from whey to milk, eggs soft-boiled and poached, to custard in cream, etc. He seemed so hungry and craved food in the form of a square meal that I put him on a rather liberal diet more quickly than I ordinarily would in an obscure

#### PERSISTENT EMBRYONAL TYPE OF LARGE INTESTINE

surgical condition. I gave him no medication except the milk of magnesia and an enema every other day for his bowels, which improved their action when he obtained more food. About a week after I first saw him he had a period of uneasiness one evening which grew into pain in the epigastrium. This was relieved by a hot stupe and he fell asleep. The next day he went on with the same liberal diet that he had been on. He continued good for four days, gaining rapidly in strength. He then had a second attack of abdominal pain about twelve hours after eating supper. He vomited at that time some prune skins, though nothing else from a hearty meal the night before.

The case looked to me as one where his ptosed stomach brought about a pyloric contraction due, possibly, to pulling down of the stomach, though there was no apparent distention in the stomach or intestine during the time I saw him. The magnesia seemed to relax this spasm by aiding in rendering the duodenum alkaline, which probably had not a sufficiency of alkaline secretion to neutralize the large secretion of acid gastric juice which may have been present.

Under date of August 2, the patient wrote:

My condition is good. I have gained almost all my lost weight and have gained in strength so that I can walk a few miles and play tennis. My intestines seem to be assuming a normal state.

In a paper entitled "Unusual Cæca in 130 Autopsies," Byron Robinson states that in two there was complete and in ten partial non-descent of the cæcum. He attributes the failure of the intestine to completely develop and rotate to intra-uterine peritonitis. There is no direct evidence, however, that this is the case.

From recent articles published it would appear that non-descent of the cæcum is not rare but that it varies greatly in extent. When the cæcum is placed as in Case I, it becomes very difficult to differentiate the condition from an inflammation of the gall-bladder or possibly a gastric ulcer.

In Cases II and III the exact diagnosis may be quite difficult and the point of opening of the abdomen becomes important. Charles Mayo reports a case in which the McBurney incision was first made, but as the appendix lay beyond the median line it became necessary to make a median incision in order to complete the operation. In this connection we would state our preference for the rectus incision in all appendiceal cases because of the ease of reaching other organs by simply enlarging the incision.

If on opening the abdomen on the right side the small intestine, un-

## H. BEECKMAN DELATOUR

covered by omentum or large bowel, presents, we should at once suspect the possibility of non-rotation of the large intestine and the presence of one of the above described embryonal types of large intestine.

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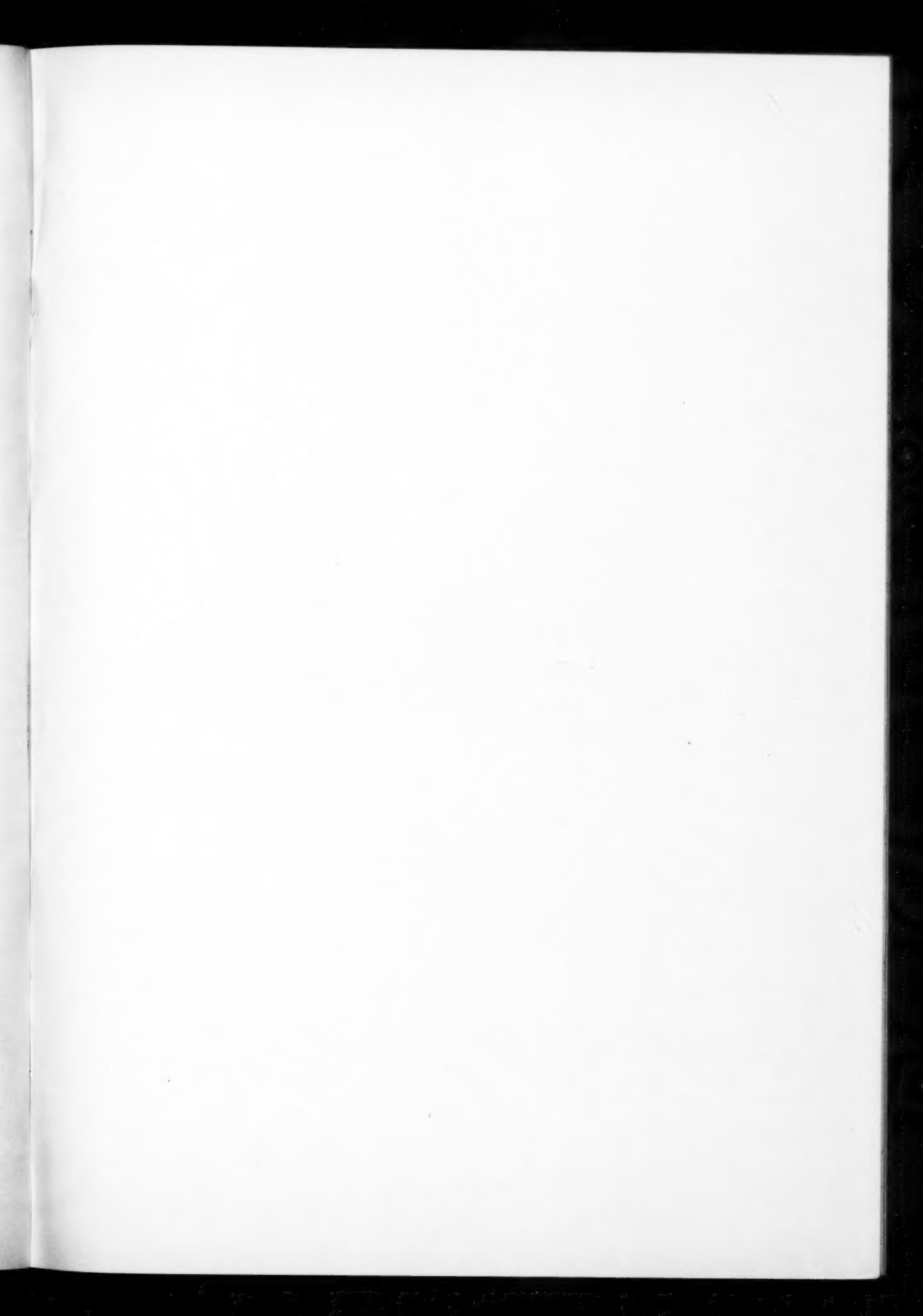
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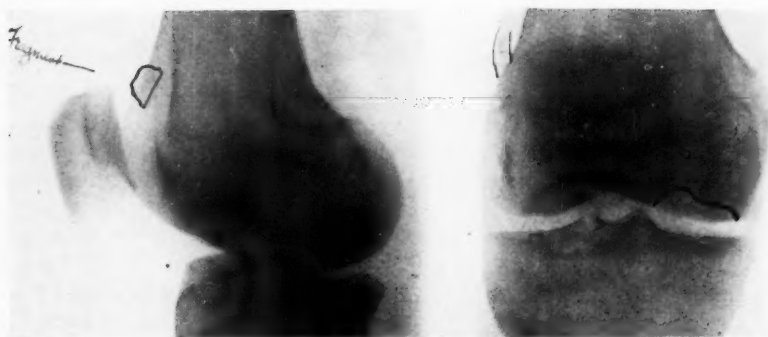


FIG. 1.—Lateral and anteroposterior X-ray views, showing area of fracture.

## FRACTURE OF THE TIP OF THE INTERNAL CONDYLE OF THE FEMUR

LOOSE BODY IN THE KNEE-JOINT

By MILTON G. STURGIS, M.D.  
OF SEATTLE, WASH.

THE unusual character of this fracture as well as the unusual picture of a foreign body presumably free in the knee-joint, for a period of six weeks, without causing discomfort, are my sole excuses for presenting the following.

The patient, a well-developed man physically, on March 20, while alighting from a slowly-moving automobile, slipped, wrenching his knee; he was not disabled but was discommoded; there was slight ecchymosis in the popliteal space, and he was slightly lame.

Because of an accident policy he consulted me on April 10, and an examination, without X-ray, showed no tenderness in the joint, no fluid, no limitation of motion, no discernible abnormality of the joint, but only an old ecchymotic area behind the knee.

He was able to keep at his work (that of carpenter) until May 1, when his knee suddenly "locked," which it did with increasing frequency until May 18, when he again consulted me. While examining him at this time, the knee suddenly "locked" with an acute spasm of the vastus internus muscle. An X-ray, taken immediately after, disclosed a shadow in the suprapatellar fossa on the inner side. Operation was advised and accepted.

On the morning following the patient objected to operation, because he said, "the fragment has slipped back into place and the knee is all right"; but acceded on explanation that his trouble would recur.

On opening the joint we were unable to find the foreign body in the location shown in the X-rays. The incision was then extended and an examination of the joint disclosed the fragment as well as the area of fracture in the internal condyle. The appearance of the latter indicated that apparently there had been complete separation of the fragment at the time of the original injury. This fragment then had been loose in the articular portion of the knee-joint for about 40 days without causing any marked discomfort, which latter resulted only when it had slipped into the shallow suprapatellar fossa.

The disparity shown in the X-rays between the size of the shadow of the fractured area in the condyle, and the size of the shadow of fragment, is to be explained by the fact that only the osseous portion of the fragment cast any appreciable shadow.

## JOINT MOUSE

BY LEONARD W. ELY, M.D.

OF SAN FRANCISCO

(From the Laboratory of Surgical Pathology, Leland Stanford Junior University)

IN spite of all that has been written on the subject of joint mice, the origin and method of formation of these bodies have never been settled definitely, and still form interesting subjects of study. A search through medical journals, especially through German journals, of the past few decades will reveal a large number of articles dealing with joint mice, and a great difference of opinion regarding them. To any one familiar with the bibliography of joint mice the case which I am about to report should prove interesting in several respects, notably as to the place of origin of the body, its structure and the history.

A joint mouse is defined usually as a loose piece of cartilage, or of bone and cartilage, in a joint, but this definition is much too broad, for it would include the fragments of bone and cartilage set free as the result of joint tuberculosis, tabetic arthropathy, arthritis of Type II,<sup>1</sup> etc. In point of fact, the essentials of the morbid process at the bottom of arthritis of Type II, etiologically and pathologically, are probably identical with those at the bottom of joint mice, but when we speak of a joint mouse we have in mind a condition in which the loose cartilage is the sole or the main element.

My patient was a well-nourished married man of twenty-one years of age, a teamster and a boxer. He denied syphilis and gonorrhœa, and gave a history of jumping from his wagon, six months before, in perfect health, and injuring his left knee. He had had no symptoms previously in his joint. The injury was followed immediately by pain and swelling.

The symptoms persisted and forced the patient to seek relief at the Lane Hospital.

Examination showed marked swelling of the left knee, with obliteration of the normal joint contour. The swelling was tense, and evidently was due to fluid in the joint. Motion was markedly restricted, and sensitiveness was present over the medial aspect near the joint line. A hard, movable body of about the size of the

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<sup>1</sup> Arthritis of Type II corresponds to the arthritis deformans of the Germans, the osteo-arthritis of the English, the hypertrophic arthritis of Goldthwait, the degenerative form of Nichols and Richardson, etc.

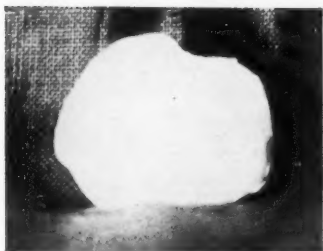
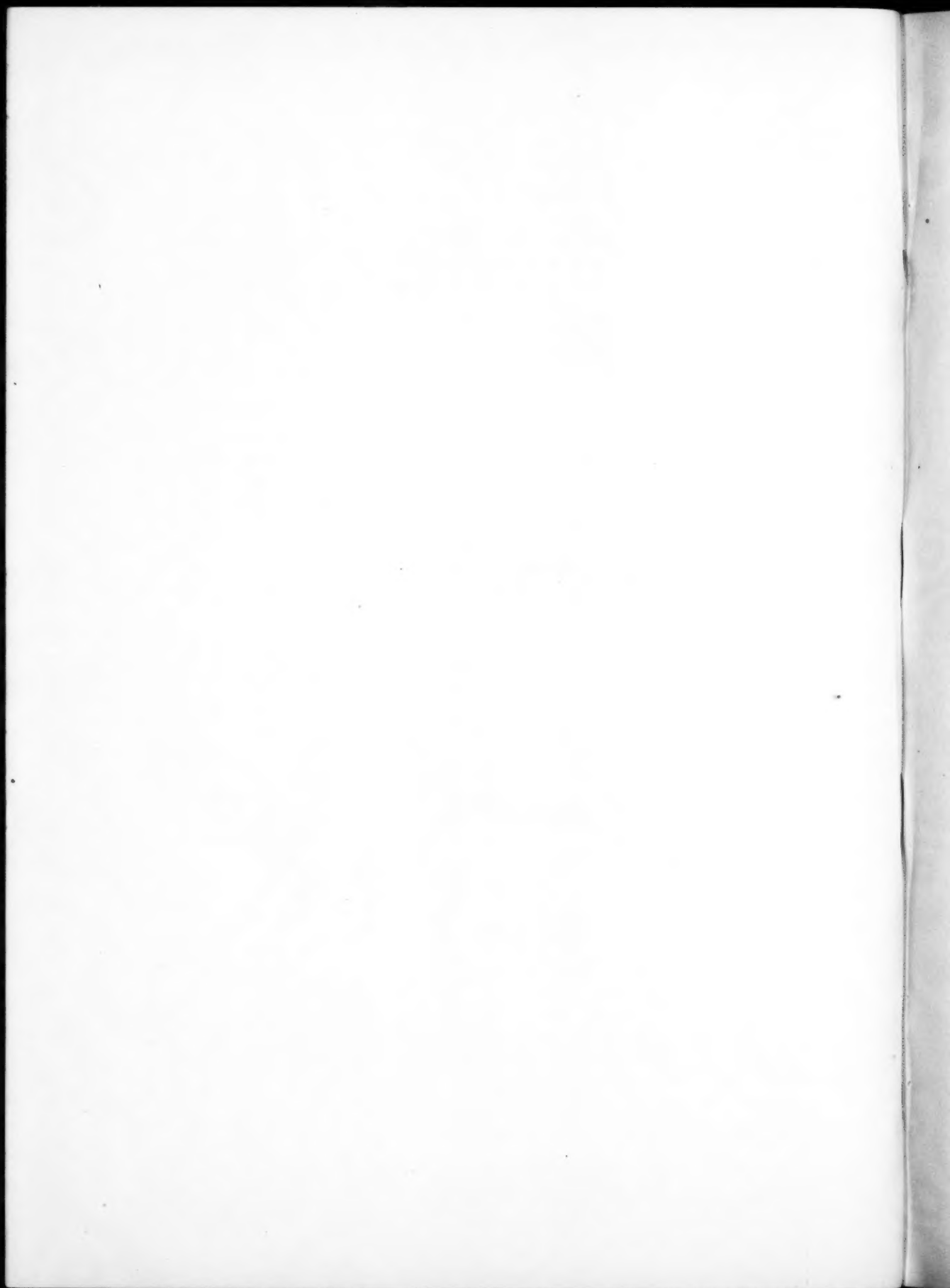


FIG. 1.—Loose body removed from joint, natural size.



FIG. 2.—Showing defect in surface of condyle of femur produced by the separation of the portion of cartilage.





## JOINT MOUSE

end of the thumb could be felt in the lateral part of the joint, slipping about under the examining fingers.

*Operation* (April 13, 1914).—Under ether the joint mouse was located in the lateral part of the joint, and, while I held it between my fingers, my assistant made an incision, about 6 cm. in length, through the skin directly over it, and then an incision, about 3 cm. in length, through the capsule. A quantity of reddish, straw-colored fluid escaped. With a pair of toothed forceps the assistant seized the body and withdrew it. The wound was then sewed up with catgut in layers.

The subsequent course was uneventful. The patient walked with crutches on the tenth day, and left the hospital on the thirteenth day.

The joint mouse was a disc-shaped piece of glistening, normal-appearing cartilage,  $27.5 \times 22.5 \times 10.5$  mm. in diameter, perfectly smooth on one side, but more uneven on the other (Fig. 1). One of its borders was notched. Its uneven side was covered with what appeared to be a thin layer of fibrous tissue. The body looked as if it had come from the condyle of the femur. On section it was found to consist exclusively of cartilage.

An anteroposterior skiagram of the knee showed an area of rarefaction in the medial condyle of the femur (Fig. 2), closely corresponding to the shape of the loose body, and a lateral skiagram showed a production of bone on the anterior surface of the medial condyle, corresponding again to the size of the body, and looking as if it had taken the place of the lost cartilage.

Cross-sections were made of the cartilage, imbedded in celloidin, stained with eosin and hæmatoxylin, and by Van Gieson method, and mounted in balsam.

*Microscopical Examination.*—This showed that the body was made up of cartilage throughout, except for a thin layer of new connective tissue on the surface towards the femur.

In the most superficial part of the superficial layer (the narrowest), the cells are arranged parallel to the surface, as in an articular cartilage. Deeper in, they are in larger groups and have lost their parallel arrangement. They are without capsule, and resemble fibroblasts rather than cartilage cells. Most of them are fusiform. They are arranged singly or in groups of two, three or more. Their nuclei stain well.

Very close to the surface one sees here and there gaps in the cartilage, filled with fibroblasts and collagen—connective tissue.

In the second zone, wider than the first, the cells are arranged in groups, and throughout each group the matrix stains rather deeply with hæmatoxylin, giving this zone a blue color perceptible to the naked eye. A few of the cells are in their capsules, as shown in the photomicrograph, but for the most part the cells are without capsule, and the cell body

cannot be distinguished from the surrounding matrix. Some cells have lost their nuclei. The general cell arrangement is perpendicular to the surface.

In the third layer, the deepest of the three, the cells have no definite alignment, and are arranged in groups of two to ten or more. Many of them are dead, but many stain well, and show definite capsules. The diffuse blue stain seen in the second layer is not present here.

Deep in the third layer, at or very near its lower limit, are gaps or cavities of larger or smaller size containing more or less detritus and some calcified material. The walls of these cavities show for the most part a thin layer of calcification.

Below the cartilage again—that is, on the under surface of the body—is the layer of connective tissue. This consists largely of young, cellular fibrous tissue, which either borders directly upon the cartilage or is separated from it in places by a layer composed of cartilage cells in a collagen matrix, looking much like fibrocartilage. For the most part these two layers are rather sharply marked off from each other by a condensation of fibroblasts, but occasionally the boundary between the two is not well defined. Three or four giant-cells can be seen in the young fibrous tissue, looking like typical marrow megaloblasts.

We shall not build up an elaborate theory of the origin of "Gelenkmäuse" from this specimen, but several points are worthy of mention.

1. The body originated almost undoubtedly from the medial femoral condyle, as shown by the Röntgen picture.

2. Its former site has been filled with bone, as shown by the Röntgen picture.

3. Its comparatively smooth femoral surface covered completely with new fibrous tissue, and the absence of any bone spicules or of marrow, show that it was not broken off immediately by the injury.

4. While many of the cartilage cells are dead, distinct evidences of proliferation are present. The body is thicker than the normal femoral cartilage. This demonstrates that the cartilage could not have been killed at the time of injury, and then have been dissected off later by the marrow, as in the recent experiments of Axhausen on animals' cartilages.

## KELOID FORMATION IN THE NEGRO\*

BY ADDISON G. BRENIZER, M.D.

OF CHARLOTTE, N. C.

THOSE of us in the Southern States devoting our time to surgery and anatomy, and of a necessity having the negro among our clientele, are in a position to observe many physical and functional differences between the black and white races. One of the most interesting conditions to which the negro shows a marked susceptibility is the development of keloids.

It is a common and almost daily observation to see among our negroes those bearing scars on their necks and chests marked by an excessive tissue formation. Some of these growths are quite large and others very fantastic, taking on the most bizarre forms (Figs. 1, 2 and 3). A great many give the history of a former "scrofulo" (cervical tuberculosis adenitis) where the glands have either broken down or have been excised. The growths are most common in wounds healing by granulation, but some follow a minimum injury or irritation, like the piercing of the ear-lobes (Figs. 1 and 2). The neck and chest seem to be sites of predilection.

Nevins Hyde claims to have proved the presence of the tubercle bacillus in certain keloids, and Gougerot has gathered an ensemble of clinical, histological, bacteriological and experimental data in favor of the tuberculosis origin of keloids. Other authors like Landouzy, Menard and Lamy also insist upon the relation between tuberculosis and keloid formation. It may be of significance and bearing upon this relation that the negro is so especially susceptible to both tuberculosis and keloid formation and that keloids frequently develop upon old tuberculous lesions bordering the skin. The sites of predilection, the neck and chest, might also point to a tuberculous origin, in that tuberculous infections might spread from these locations through the lymphatics, following the distribution of these vessels and settling at a point of least resistance.

There are, however, many facts to disprove the tuberculous and infectious origin of keloids and to place them rather under the head of tumor growths. Hallopeau speaks vaguely of the lesion, that it is "only a manifestation of a morbid tendency peculiar to the subject." He means

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\* Read before the North Carolina State Medical Society, June 16, 1914.

by this statement simply that he does not know the provoking cause of keloids any more than he knows the cause of other tumor growths, but that the keloids like these growths do not resemble any of the results of bacterial action. A keloid may develop along the whole length of a scar or only at the point of a single stitch hole, respecting many other stitch holes along the line of the incision. It must be admitted then that this alteration of the cicatrix does not depend solely upon a question of a fertile field for bacterial growth. Figs. 1 and 2 picture a large keloid following a needle hole made in each ear, and there is also a keloid over the right buttock of the same patient over a burn. This case would suggest that the tendency to keloid were not local but a general disposition. Fig. 3 shows a case of keloid formation in old syphilitic scars on the chest and in a scar under the lower jaw, the result of a cut. This case also suggests the tendency to keloid formation on the part of the negro, irrespective of the character of the local irritant. Keloids spring up apparently without local irritation just as other tumors do. It is always possible, however, that the growth arises in response to an irritation less than a needle prick, the causative factor in the case shown in Figs. 1 and 2. Out of 20 keloids gathered by Bloodgood among 200 benign connective-tissue tumors, 6 of the keloids were spontaneous, the so-called "true keloids," and 14 occurred in scars, the so-called "cicatricial keloids."

Histologically, the keloid is a fibroma of the skin arising in the connective tissue of the derma. The epidermis is adherent over the tumor and is very thin. Occasionally in spontaneous keloids, more often in cicatricial keloids, and especially when they are recurrent, areas of spindle-cells resembling a sarcoma are found. The growth is prone to recur locally after the removal but does not metastasize. This is due to the structure, the close cohesion of cells and low vascularity, the structure of a fibroma. Cicatricial keloids rarely disappear spontaneously after several months. In most keloids no bacteria nor parasites are found and those objects taken for parasites are doubtless due to faulty fixing and staining.

Owing to the analogy of experience with so many diseases which have proven to be of bacterial origin, as with the tubercle in tuberculosis and the gumma in syphilis, the cause of keloids has often been attributed to microorganisms and parasites. Since the keloid is histologically a fibroma and histogenetic studies have established that the keloid does not grow through changing the surrounding cells into tumor cells, but grows as a mass of foreign cells from an original focus and does not (as for example, the tubercle and the gumma) involve the

FIG. 1.



FIG. 2.



FIGS. 1 and 2.—A case of keloid formation hanging from the lobe of each ear. Fig. 2 shows the large growth on the right side. The tumors sprang from the sites of holes pierced through the lobe of the ear. The patient also has a similar growth over the right buttock arising in the scar of a burn. The tumors grew rapidly for several months and have remained about the same size for more than a year.

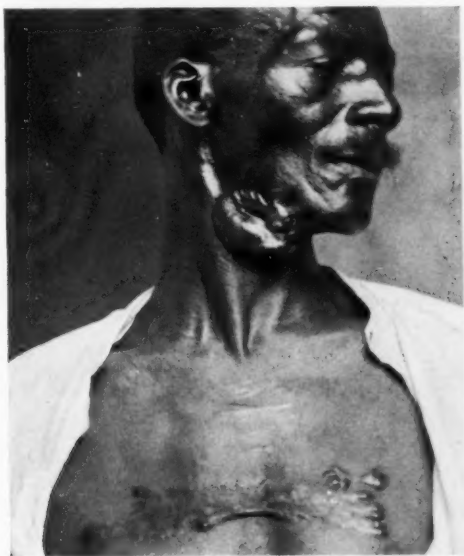


FIG. 3.—A case of keloid formation over the chest in old syphilitic scars. The negro tells an interesting story, that he was born with two child's hands crossed on his breast, and picks up small money by showing them to those curious enough to look. There is also a keloid mass just under the lower jaw on the right side occurring in the scar of an old cut. It is interesting that a number of individuals in this same family bear keloids developing in scars, the result of injuries of different natures. I know of keloids in a nephew and a niece, one occurring in the scar of a broken-down tuberculous gland and the other in a scar of a burn.





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surroundings directly in the process, they differ in this from all known effects of bacteria. Extracellular parasites could only be attributed the power of offering the impetus to change of normal cells into the cells of the tumor and leave the further growth, in consequence of the biological changes, to continue its course. The keloid would be only in its beginning a parasitic disease. Intracellular parasites would have to possess this same peculiarity of behavior, which has never yet been seen in the case of any known parasite. It could only be an absolutely specific adaption of the parasite to the tumor, which is so perfect that it immediately becomes absorbed by the cells from which the growth springs; and the idea that there is a particular causative bacterium, simply to agree with the law of specificity of bacterial action, is not at all substantial. For how can one imagine a parasite which may affect certain cells, prompt them to continuous growth and immediately lose the power to affect other cells!

Even in granting that the keloid, like other fibromata, is a neoplasm due to definite defects of normal tissue cells, the cause is still obscure. We know only that the etiological factors must so act as to produce these changes in the cells. And all theories of etiology which do not consider the histogenetic and biological facts are worthless. There are, however, many possibilities which remain and can be divided into two large groups, according as one may attribute the origin to congenital malformation or to outward irritation.

Hereditary dispositions, with the elimination of every other acquired cause, are very difficult to prove. It is accepted, however, that many tumors arise from congenital malformations and from misplaced germinal cells; others show no such indication. On the other hand, we observe a striking relation between an outward injury and the formation of tumors. There are thousands of cases already recorded where tumors follow traumatic, thermic and radial injury. Even normal cells are prompted to proliferation and alteration by such injuries, but there is a return to normal or to a state of equilibrium of growth. Whatever checking force or inhibitory substance there is to control the growth and shaping of the body tissues again exerts its influence. It would seem that, in the case of normal cells, there is first a paralysis and then a regeneration of some inhibitory substance, while, in case of tumor cells, the paralysis is followed by a more or less feeble restoration of this inhibitory substance. It remains a vague speculation as to what this inhibitory influence is; whether it be a substance in the blood serum, the nervous system through so-called trophic nerves or locally, the cohesion of the cells.

Can irritation so act as to produce a paralysis of an inhibition of growth? We know that normal cells are checked in their overgrowth at a certain point by some inhibitory influence. When, on the other hand, cancer cells are irritated, the capability of restitution is seen to be entirely wanting or very feeble. This fact is based on many clinical observations and is shown brilliantly in a few of the researches carried out by Ehrlich. According to him, through the effect of moderate heat and cold, slowly growing cancer cells in mice could be brought to a rapid proliferation without check. Michaelis was able to produce, through warming the cells to  $45^{\circ}$  C., a lasting increase in volume of cancers in mice. Along this same line the work of Clowes and Baeslack showed that cancer cells, through warming to  $37^{\circ}$  to  $40^{\circ}$  C., could be made to take on a lasting continuous accelerated growth; but this action was shown to take effect only on the slow growing tumors which are less inclined to degenerate. As with normal tissue, every irritation producing overgrowth depends upon the removal of some inhibitory substance. The above experiments agree with the law. The difference with cancer cells is that the growth continues its gained activity and that a selective action of stimuli, as to quality and time of application, is not necessary.

The difference then between normal cells and tumor cells rests upon three factors. First, the power of checking a growth once begun and restoration to an equilibrium of growth, as occurs with normal cells, does not prevail. This difference in the cells themselves is certainly necessary for the development of a tumor. The condition is produced by some irritant paralyzing the growth—checking influence. If the power of regeneration of this inhibitory force preponderates over its destruction by the irritant, the growth must sooner or later terminate because the inhibitory force is restored to normal. In such a case, not a malignant but a more or less malignant tumor arises. Second, if even as much inhibitory substance regenerates as is destroyed, then inhibition of growth remains unchanged and a normal development takes place; a lasting continuous growth (a cancer) takes place as soon as the inhibitory action is removed through irritation. Third, if the capability of restitution has sunk so far that the irritation destroys more of the inhibitory substance than is formed, then a rapidity of growth takes place, more and more rapid, until an indefinite maximum is reached; that is, a cancer is formed.

These factors just cited would serve to explain the development and growth of keloids, as well as other tumors. In the case pictured in Figs. 1 and 2 it is seen that a keloid may arise following an irrita-

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tion of the slightest intensity. Cancer cells can be made to grow rapidly following the slightest irritation. In the case of the keloid there is evidence to show both a single and multiple response, through growth, in various parts of the body of the same individual and to irritants of different character; in Fig. 3 is seen a keloid arising from an old cut under the jaw and another from an old syphilitic scar over the chest. The irritant, of whatever character, acts by overpowering the inhibitory substance and the cells are allowed to grow. The fact that a keloid appears spontaneously may mean only that the irritant has been mild and has gone unnoticed. The fact that some keloids disappear spontaneously may mean, on the other hand, that the inhibitory substance has regenerated.

Why are keloids so much more frequent in the negro than in the white man? The negro is much more susceptible to all connective-tissue tumors than the white man, about 2 to 1. The negro at birth shows many gross congenital malformations and, on the dissecting table, many anomalies of blood-vessel and nerve formations confuse the student as he follows his text-book guide. These perverted structural conditions point to an instability in the equilibrium of growth. There must be some disturbance of an inhibitory influence which holds the growth of the cells in check and prevents their growth at random. If the abnormal growth of cells is due to an injury of an inhibitory substance, this substance must first be injured before the cells can grow. This inhibitory substance is then more sensitive than the cells themselves. If we possess evidence of a much greater preponderance of abnormalities of growth and tumor formation in the negro than in the white man, we may know that this inhibitory substance is weaker and more unstable than in the white man. Therefore, irritation which might pass without a demonstrable effect in the white man, might so injure this inhibitory substance in the negro as to allow an overgrowth of the dermal connective-tissue cells and the formation of a fibroma, a keloid.

## FIXATION OF SIMPLE FRACTURES

BY JOHN O'CONOR, M.D.

OF BUENOS AYRES

SENIOR MEDICAL OFFICER OF THE BRITISH HOSPITAL

It seems somewhat of an anachronism that, even with the assistance of skiagraphy, some standard has not yet been fixed whereby we might harmonize our treatment of simple fractures in conformity with the facilities which modern surgery affords, and in consonance with the natural factors which govern the repair of living tissue.

Judging from some recent publications, there appears to be a tendency to ignore the fundamental basis of our healing art—rest. Early massage, early movement, indeed ambulatory treatment have their advocates, who repeatedly ventilate the perfection of their respective procedures, and, in order to show the valuation which they place on nature's remedy, such volcanic organisms as cats are taken as suitable experimental mediums on which to found theories, and to condemn the cumulative experience of ages, so well expressed in the classic work of Hilton, which, by the way, in my humble opinion, possesses even greater value to-day than when first published.

If one pauses to consider the rationale of the treatment of any injury, be it of bone or flesh, surely it is absurd to think that any wound can be cured by surgery *per se*; living bone is not wood that can be hammered and indefinitely held together by bolts or nails. Living cells with their living cement are the primordial factor in the business, and the object of surgery is not to displace but assist the natural process of repair, by removing such conditions as may hamper the osteoblasts in the execution of their great and secret mission.

It has fallen to my lot to have had a quarter of a century's hospital experience in the treatment of fractures, the total of which runs into four figures, and consequently I have had the opportunity of forming some ideas on the subject, one of which is, that it requires 30 days' absolute rest on a properly adjusted splint for the callus to set in the fracture of a long bone of any healthy adult, quite irrespective of the means, surgical or otherwise, by which correct apposition has been secured. Not being endowed with an over conservative turn of mind, I have been tempted from time to time to try some of the would-be time-saving methods, but sooner or later found them to be time-losing ones, and so prolific in regrettable incidents that I am now forced to con-



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tent myself with nature's mandate—put the fragments in apposition, keep them in it, and leave them at rest.

I do not think it is exaggeration to state that the reparative process attending a radical cure of hernia, or a perineoplasty, is identical to what takes place in the union of a broken bone. But I have yet to find the person who advocates early muscular movement or ambulatory treatment in the former conditions. In particular, I wish to note the similarity in the healing of wounds of bone and perineum, in that the rapidity of union seems to be in direct ratio to the rapidity in which the severed parts are approximated. And although the same cellular law applies equally to the cure of a ruptured perineum or recent fracture, the surgical conditions are very different; in the former the surgeon is assisted by the use of his eye-sight, but in the latter, even with the aid of X-rays, it is almost impossible to exclude the presence of interposing strips of torn muscle, periosteum, and clots—a difficulty particularly accentuated in the very common oblique spiral fractures.

During the past three years I have had the embarrassing experience of finding in six cases of simple fracture of the shaft of the tibia no attempt at union after five weeks' careful splint treatment; in each little or no deformity existed, and alignment appeared normal, but at subsequent operation torn masses of muscle were found wedged between the fragments in four, and in two an overlapping curtain of torn periosteum. This kind of thing is, indeed, bewildering, not only as to the commercial loss of valuable time to the patient, but in the reflection that the osteoblastic tide has ebbed, which, taken on the flood, adds so much to rapid and sound union.

The "wait and see" theory may be a useful formula for the expectant politician, but remembering the fact that the cementing activity of the osteoblasts seems to decrease in direct ratio to the delay in which their services are utilized, I am not at all sure that it is a good one for even the expectant surgeon.

My experience has forced me to adopt the more direct one, "look and see," and I confess the more I do see, the more I wonder, considering potential inhibitory obstacles, at the marvellous reparative power the human body possesses, in that an oblique fracture of any long bone ever unites without operative assistance.

And moreover I venture to state that, considering the favors which Lister and Lane have conferred on bone surgery, it is mocking reason, knowing the handicap which the natural curative process has to carry in such cases, not to seize the earliest opportunity of removing interpos-

ing "foreign bodies," and to effectively overcome displacement caused by powerful muscular traction.

Doubtless these statements will be reckoned rank heresy by those, for example, who possess the faculty of diagnosing the exact pathological condition of an infected appendix without the employment of the sense of sight. But even at the risk of being outlawed for my lack of perspicacity, I confess I can no more prophesy that an oblique fracture of the tibia or femur will be united in six weeks without operation than I can that an infected appendix will not perforate within forty-eight hours.

I am unable to follow the reasoning of those who advocate early movement, for in the many cases in which there is mechanical obstruction to approximation of fragments, it can only result in making confusion worse confounded.

As to its use in conjunction with the application of bolts or plates, except in diseased conditions or old age, the one appears to me to be the negation of the other, not to mention the fact that it is usually the custom to allow time for a plaster case to set before the patient is allowed to move it. And finally, as to the value of early massage, after giving it a trial for two years, we came to the conclusion that its virtues—diminution of pain and swelling, and prevention of stiffening of joints—were more than compensated by its defects—unexpected displacement of fragments, and an increased percentage of ununited fractures.

Consequently I made it a rule to defer its benefits for four weeks, until union was established.

In order to make matters clear, it may be well to state my practice in detail.

Assisted by X-rays, I treat simple transverse fractures by absolute rest on splints; if at the end of four weeks union appears defective, I operate, remove any intervening tissue, revivify the surface of fragments and plate. In all oblique fractures I operate as soon as I have completed the necessary technical dispositions, so as to insure an aseptic wound.

During the past twenty years I have used wire in scores of cases (during later years strong eleven-day catgut), but since I adopted Sir Arbuthnot Lane's method I have found that I can do in ten to twenty minutes infinitely better work with much less disturbance of parts, and consequently much less risk of supervention of sepsis.

I regret that I did not adopt this procedure years ago, as it would have obviated, to say the least, much temporary annoyance when the twisted wire broke, or the fragments slipped their moorings on ad-

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justment of splint. With Lane's plates a surgeon has at his disposal the easiest means that I know of of securing rest to the parts; they assure retention of fragments in exact position, cause no irritation, and it is extraordinary, as I have frequently demonstrated to onlookers, the ivy-like manner in which the periosteum covers and caresses the underlying plates.

I consider it a duty to take this opportunity of refuting a statement made in a recent Hunterian lecture that "the screws loosen after a short time," and are consequently useless! I much regret that a distinguished surgeon, for whom I have the most profound respect, should have his name associated with such a travesty of fact. Many of the patients on whom I have operated are railway employees, and as they were particularly exposed to injuries, I considered it expedient to remove the plates before they left the hospital.

Knowing what Sir William Macewen's ideas were with regard to the effective duration of ligatures, pins, etc., in the living body, I was much astonished to find in my first case that it was impossible to pry the plate out of its position by a strong elevator, and I was further more surprised to find that the screws retained their grip so tenaciously for six weeks, that I had to use almost as much force in unscrewing them as I had to insert them.

Being much interested in the matter, I purposely invited my colleagues to witness ten consecutive removals: result—in not a single instance was it found possible to remove the plate without the employment of the screw-driver.

Since this paragraph was written I have had the opportunity of further verifying the matter. Two patients were plated on January 29 for simple fracture of shaft of tibia, and removal of plates was deferred to the fifty-third day, so as to intensify the test, and in order to expunge the personal element, I invited my colleague Dr. Healy to remove the plates, each of which contained six screws; he, too, found it impossible to remove a single screw without the turnscrew, and, moreover, called my attention to the circular indentations which the screw holes in plates had made in the bone. In both cases the periosteum, plate and bone seemed one naturally welded mass.

The method of operating by which I obtain such results is as follows:

The part is well painted with tincture of iodine, and the whole field isolated by dry sterilized towels. Taking the line of fracture as centre, a four to six inch incision is made along aspect of bone in which there is the least danger of injuring anatomical structures; whenever feasible, as in tibia, the knife is inserted at one extremity of line of incision and

JOHN O'CONOR

made to sever all the structures, including periosteum, in one sweep right through the whole length of wound; the periosteal elevator is at once applied and the flaps retracted in mass.

In my opinion this is a most important detail, for it obviates dissecting room manœuvres which cause unnecessary exposure of planes of areolar tissue, and the formation of potential spaces for the incubation of germs, and, furthermore, considerably facilitates approximation of edges of periosteum by interrupted through-and-through strong silk sutures.

If necessary, I never hesitate to protrude the fragments, in order to carry out proper inspection and thorough removal of buffers of torn tissue and clots; and, moreover, I frequently use a saw or bone-cutting forceps to dress the fragments, so that the surfaces of same may remain in the best possible position and condition for union. No tourniquet is employed, bleeding points are ligated, and sutures so inserted as not only to encircle the periosteal edges, but placed at a sufficient distance apart so as to provide for automatic drainage in case of subsequent oozing. And it is well to remember that the value of through-and-through sutures for deep approximation purposes depends entirely on their being properly tied, viz., tension made and knots placed at stitch-holes along one side of wound. If there should be the slightest sign of shock in this, or any other operation, nothing in my experience equals a rectal injection of a pint of champagne.

No extension apparatus is made use of; splints are carefully adjusted, and at the end of each week the nurse changes the dry gauze dressing. After the thirtieth day, the splint is daily temporarily removed, and the patient requested and encouraged to gently move the corresponding joints; the limb is then replaced on splint and gently massaged for ten minutes. On the forty-second day the splint is dispensed with, and massage and active movement are carried out daily until he can walk. As before stated, the plates are removed at end of sixth week; massage is, of course, omitted during the few days necessary for the healing of this wound.

If there is one point that I should single out for especial consideration in this operation, it is efficient approximation of divided periosteum, not only with the idea of securing the plates in good position, but of preventing the entrance of militant germs to the seat of osteal repair, and of preventing the escape of osteoblasts into the surrounding tissues and depositing the nuclei for the formation of masses of callus, which are afterwards a bugbear to both patient and surgeon.

I have observed that these formations are much less frequent in



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simple fractures which have been operated on than in those which have not, obviously the result of want of closure of periosteal tear in latter.

Again, if there is a point in the after-treatment which I should select for particular censure, it is what has been falsely described as "passive," but which I can only describe as damnation, movement of joints. During my twenty-five years' experience I have seen more joints permanently maimed by those obsessed with this relic of the Inquisition than I have seen by the ravages of the bacillus of Koch. And nothing in surgery gives me greater cause for anxiety than the application of my hands to break down adhesions in joints, for I am convinced that in at least 90 per cent. of such cases the patient's own muscles, guarded by his own sense of pain, are the one and only treatment necessary or justifiable.

Being aware of the danger I incur of starting a correspondence on the craze for early osteopexy, it may be expedient to define my position.

This paper is not written with the idea of tempting men, who have neither the skill nor means of doing such an operation in an aseptic manner, to plunge a knife into every case of oblique fracture they come across; indeed, such a result would be too awful to contemplate; but it is penned with the object of inviting the attention of those who possess the means, and are capable, to reconsider present methods, and, if possible, to take full advantage of the services which surgery affords in the treatment of common lesions which are often attended with most undesirable consequences.



## TENDON FIXATION FOR DEFORMITY RESULTING FROM PARTIAL PARALYSIS

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THE following is a report of a further development of the operation described by the writer, under the title "Tendon Fixation," in the *ANNALS OF SURGERY*, March, 1913.

The patient was a boy of five years of age, who had had anterior poliomyelitis two years before, resulting in extensive paralysis of the right lower extremity. From this he gradually recovered until he was able to walk, although with considerable disability, owing to a residual partial paralysis of the calf muscles and a complete paralysis of the *tibialis posticus*. Upon examination the calf muscle seemed to have about one-quarter of the normal power, the *tibialis posticus* no power at all, and the *peronei*, *tibialis anticus*, *dorsi flexors* and *plantar flexors* of the toes about normal power. The result was a moderate *calcaneovalgus*, the patient walking entirely on the heel and with considerable *valgus*, apparently making no use of the power still persisting in the calf.

Encouraged by the success met with in the series of 50 cases in which the writer has done tendon fixation for the various deformities resulting from complete paralysis of groups of muscles, the following operation was done.

A vertical incision five inches long was made along the outer side of the *tendo achillis*, down to the posterior extremity of the *os calcis*. The sheath of the *tendo achillis* was split throughout the length of the incision and the tendon exposed. The tendon was then split into an anterior and a posterior half from the upper end of the incision down to the *os calcis*. At the upper end of this incision the anterior half of the tendon was then cut free from the muscle. Close to the insertion of the tendon a small opening was made in the anterior portion of its sheath and the cut end of the half tendon drawn through it so that it was now entirely anterior to the sheath. The posterior surface of the tibia was then exposed by retraction of the *flexor longus hallucis*, and the periosteum divided vertically for three inches, down to the lower end of the bone. After reflecting the periosteum sufficiently a piece of bone, three inches long and of the thickness of the half tendon, was removed with a gouge and the tendon laid in the trough thus pre-

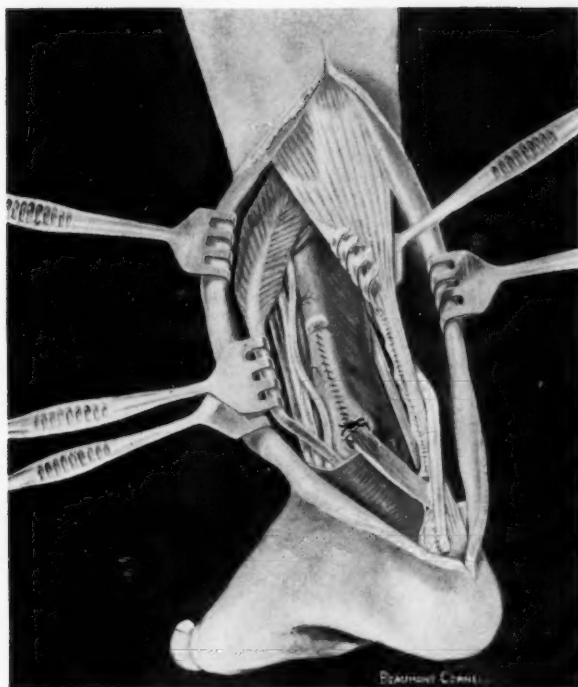
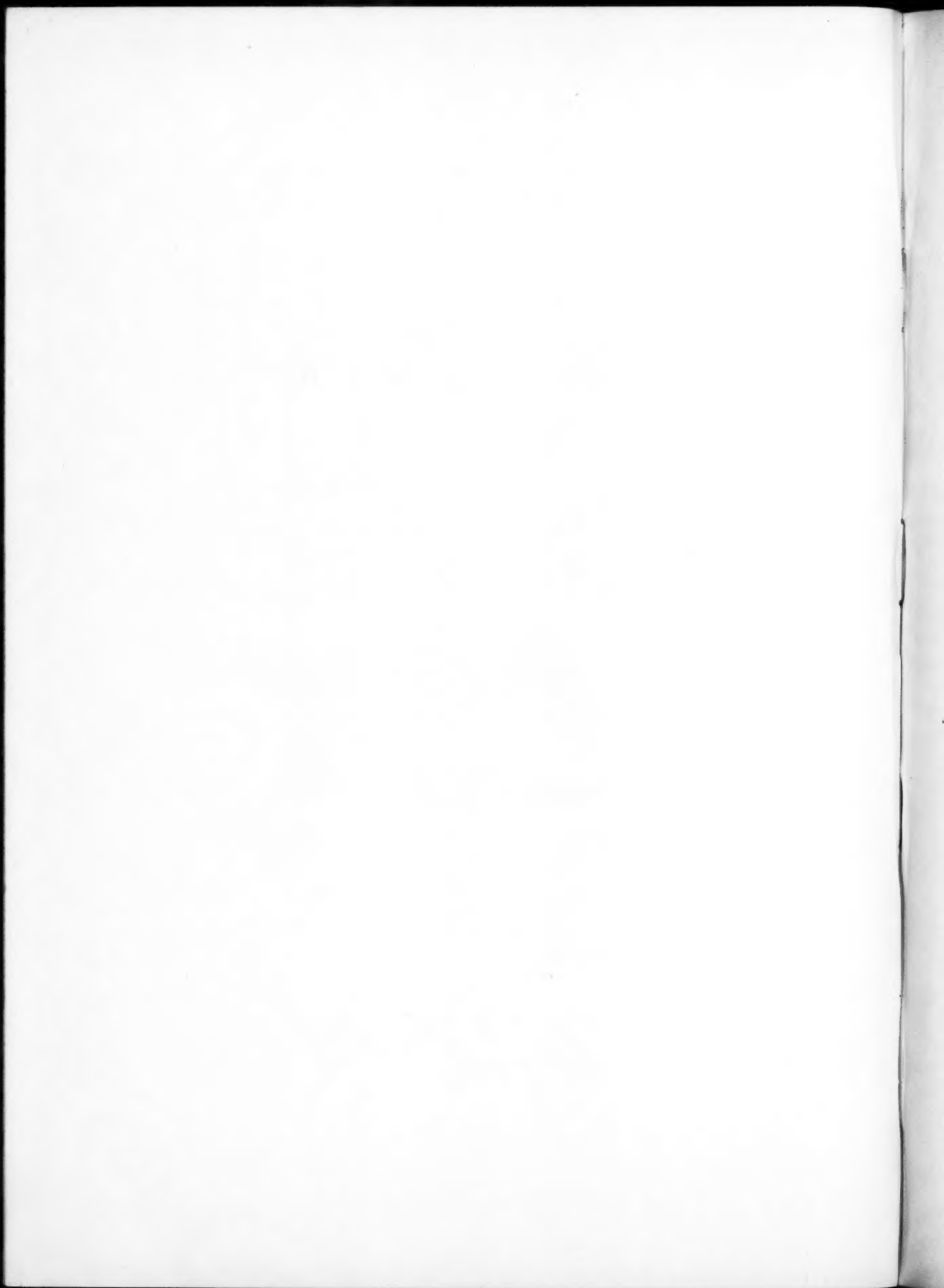


FIG. 1.—The drawing shows the flexor longus hallucis retracted so as to expose the posterior surface of the tibia. The anterior half of the tendo achillis has been sewn into the groove in the bone. The incision in the sheath of the tendo achillis has been closed and the two peronei tendons have been transplanted into the os calcis.



## TENDON FIXATION FOR DEFORMITY

pared. When this tendon had been drawn sufficiently taut to produce a slight equinus, it was sewn solidly in place with kangaroo tendon and catgut and completely covered with periosteum. Thus, passive or active dorsiflexion of the foot beyond a slight obtuse angle was made impossible.

The peronei tendons were then transplanted into the os calcis and, finally, a fixation was done on the tibialis posticus tendon to prevent the valgus deformity, the tendon being buried in the internal malleolus in the manner previously described.

Healing took place by primary union and after two months the plaster was removed. The fixations were quite solid and the peroneal transplantation successful. The part of the tendo achillis still attached to the muscle had regained its normal thickness as far as one could tell. The point of greatest interest, however, was that while dorsiflexion beyond a slight obtuse angle was impossible, the patient was able to plantar-flex the foot strongly by the combined action of the calf muscle and the transplanted peronei. Thus the deformity and disability were overcome without interference with the power present. Furthermore, after the lapse of a few weeks, during which time proper exercise was given, the power in the weak calf muscle had decidedly increased, indicating at once that a part at least of the weakness of the muscle was due to its stretched condition in calcaneus. With the assistance of a Whitman plate the patient walks nearly normally.

It is the intention of the writer to use this method on a series of suitable cases in which deformities are present in spite of a partial recovery of the muscle. If the fixations prove as successful as they have done in the case of the operations in which the whole tendon was fixed for a complete paralysis, a new operative field will have been opened up which will completely eliminate the silk ligament and reduce to a minimum the necessity for braces in infantile paralysis.

## BLOOD-VESSEL CLAMPS OF PRACTICAL UTILITY\*

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IN company with the development of blood-vessel surgery, various instruments to facilitate the work were devised; and when methods, perfected in the laboratory, were applied to human problems it was assumed that the same instruments would be equally satisfactory. This transfer has only been partly feasible, an example of non-adaptability being the blood-vessel clamp. For animals the Crile clamp served all purposes—somewhat clumsy, perhaps, but, since the exposure in experimental work is not of great importance, satisfactory. In operations on humans it has been constantly troublesome. To supply the deficiency, I have devised the compact, powerful screw-clamp (Fig. 1), here so realistically illustrated that detailed description is not necessary. This clamp has the virtue of requiring little space (Fig. 3), being easy of application and removal and absolutely adjustable. It cannot slip, and the rounded edges preclude the possibility of injuring the vessels.<sup>1</sup>

In transfusion work and other manipulations of the smaller vessels, the old rubber-shod bull-dog clamp has done noble service for many years—but it is cumbersome and tends to slip. By removing the serrations, carefully rounding all edges, and turning up the ends of the blades at right angles (Fig. 2), I have formed a very useful little instrument which cannot injure the vessel wall and cannot slip. It takes up extremely little space (Fig. 4).

These clamps have been given thorough practical trial and found to be most helpful.

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\* From the Hunterian Laboratory of Experimental Medicine, The Johns Hopkins University.

<sup>1</sup> This clamp is made in two sizes—one to fit the vessels of the extremities, the other for the larger vessels of the abdomen and root of the neck.





FIG. 1.—Screw clamp for large blood-vessels.

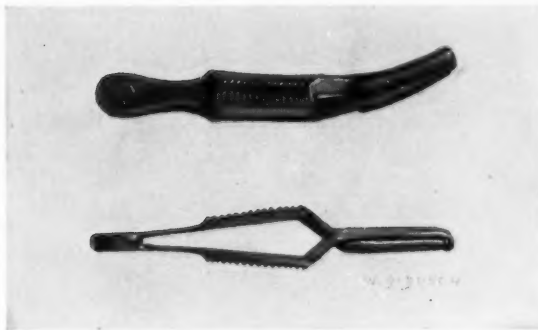


FIG. 2.—Clamp for small vessels; especially useful in transfusions.

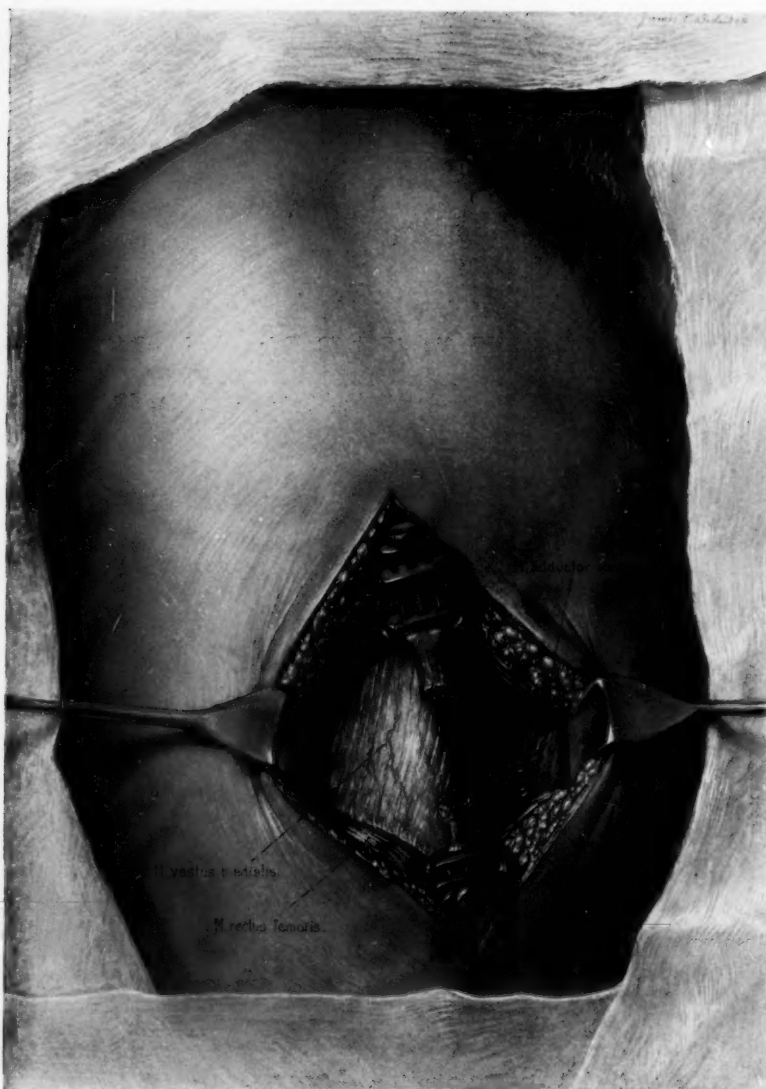


FIG. 3.—Screw clamps being used in suture of femoral artery. They occupy very little space.

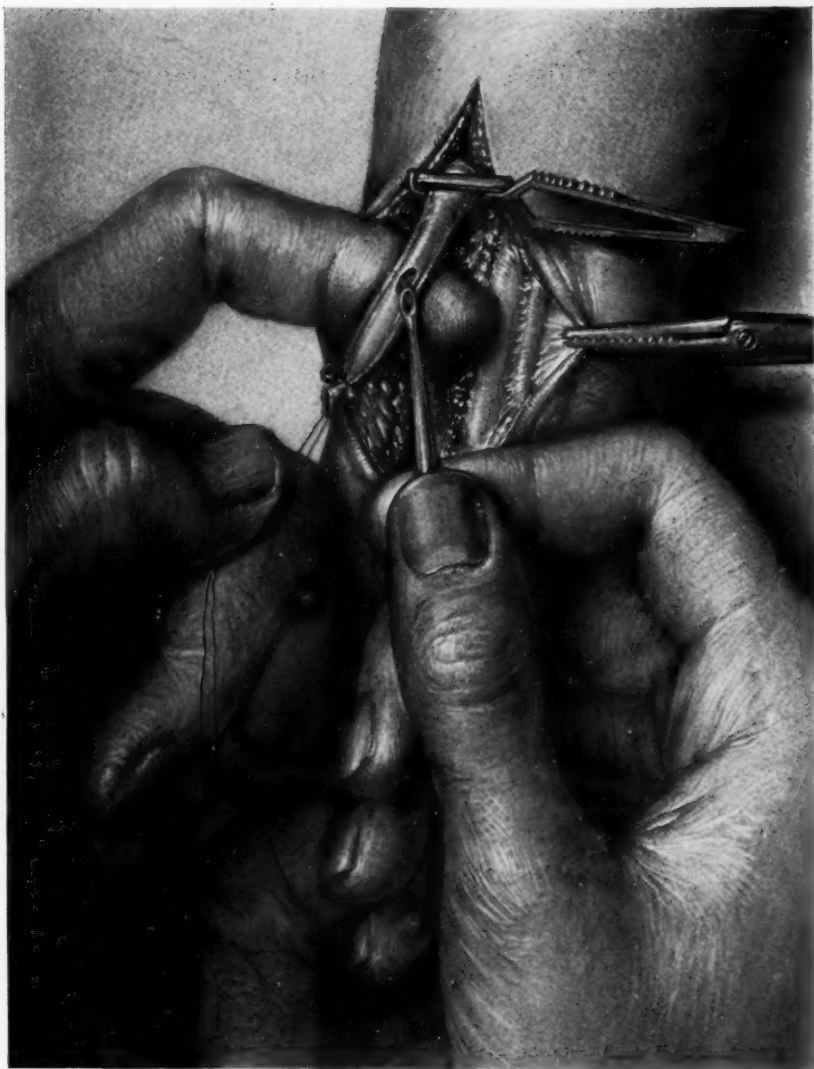


FIG. 4.—Clamp being used in a transfusion. Its right-angled end prevents slipping.



TRANSACTIONS  
OF THE  
NEW YORK SURGICAL SOCIETY

*Stated Meeting, held at the New York Academy of Medicine, October  
14, 1914*

The Vice-President, DR. CHARLES H. PECK, in the Chair

SYPHILITIC LESION SIMULATING CEREBELLAR ABSCESS

DR. JOHN A. HARTWELL presented a woman, thirty-two years old, who was admitted to Bellevue Hospital on September 10, 1914, with the history that in July, 1914, she had an acute otitis media on the right side which was suspected to have involved the mastoid. No operation, however, was advised. The discharge from the ear persisted, and about August 10 she began to suffer from headache, which had steadily grown worse, and coincident with this there was pain over the mastoid. During the past week she had grown very unsteady in her gait and had complained somewhat of dizziness. There had been no nausea or vomiting.

On admission, the patient showed every evidence of suffering acutely from headache, which she located as most severe in the occipital and frontal regions, there being no difference in degree on the two sides. From the right ear there was a scanty, thick, very foul discharge, and examination showed a swollen canal and a perforation in the membrane. The mastoid was moderately tender on pressure. Percussion over the posterior portion of the right temporoparietal region caused pain, while the remainder of the head was free from this sign.

Eyes: The pupils were equal in size and in their reactions to light and accommodation. There were no abnormalities in the ocular movements. Both fundi were congested, with dilated and tortuous vessels, retinal hemorrhages and œdema of the discs, so that their outlines could not be determined. These conditions were more marked in the left than in the right fundus.

Reflexes: All the reflexes were normal and equal excepting the left abdominal reflex, which was totally absent. There were no paralyses and no evidences of superficial sensory disturbances. There was, however, a marked disturbance of equilibrium. The patient on standing



swayed markedly, even with the eyes open, and after a few seconds pitched forward and to the left. With the eyes closed this sign was much increased. In attempting to walk she staggered, the usual tendency being to the left. The feet were not lifted from the floor, but the gait was a shuffling stagger. No muscular incoördination could be demonstrated in the upper extremities, and when lying down, coördinated movements of the lower extremities were executed.

On the left tibia there was a thickening in the middle third, occupying the subcutaneous surface and crest, about 3 x 5 cm. in extent. This was strongly suggestive of a syphilitic periostitis. There was, however, no other evidence of such an infection elsewhere on the body.

The temperature varied from 97° to 99° during the first forty-eight hours after admission. The pulse was about 90. The systolic blood-pressure was 150 mm.; the diastolic 100 mm.

A lumbar puncture was cautiously done, with the patient's head low, the danger of this procedure being recognized. Clear fluid spurted out with great force, and coincident with this the patient cried out with pain in the front of the head, but with no change in pulse or respiration. The flow was immediately checked and no fluid was collected for examination. The intense frontal pain continued for ten minutes.

This patient's history, in connection with the findings above detailed, suggested either a cerebellar abscess or a syphilitic lesion. The possibility of the latter was recognized, but the patient's condition was so urgent and the probability of a cerebellar or post-temporal abscess so emphatic, with the danger of rupture and sudden death, that it was decided to operate at once, and not await the result of the Wassermann test or of antisyphilitic treatment.

The usual mastoid operation was done and the skull removed posteriorly and upward so as to expose both the cerebellum and the temporo-sphenoidal region. The antrum contained granulation tissue: there was necrosis of its walls, and the bone extending backward along the sinus was also necrotic. The sinus itself, as far as it was exposed, was converted into a solid fibrous cord and contained no blood. The dura around it was markedly thickened and adherent to the pia arachnoid. This condition was found to be more apparent over the cerebellum than over the temporal region. The intracranial tension was markedly increased wherever the meninges were exposed, and no pulsation was present. On opening the thickened dura the temporal lobe and the cerebellum both bulged markedly into the wound. There was no excess of cerebral fluid. The finger was passed beneath the temporal lobe and the cerebellum in search of a subdural abscess, but none was located. A puncture was

#### SEPARATION OF LOWER FEMORAL EPIPHYSIS

made into each of these parts with a brain trocar-cannula, but no fluid pus could be obtained. The type of the meningitis and the fibrous cord replacing the sinus indicated that these changes were syphilitic rather than directly secondary to the mastoiditis, and no further attempt to locate an abscess was made.

The subsequent course of the disease was steadily towards recovery. Mercury and iodide had been given in full doses. The operative wounds had healed in the usual way, only a small sinus now remaining. The eye-grounds had gradually regained an almost normal appearance, but there still remained some indistinctness of the disc and traces of the old hemorrhages (Dr. Vandegrift). The intracranial tension was still above normal, as shown by the protrusion of both the temporal lobe and the cerebellum, both, however, pulsating. The gait had become normal and the headaches had entirely disappeared. The Wassermann reaction, immediately after the operation, was strongly positive. The lateral sinus, which was excised at the operation, showed a chronic inflammation, and the bone from the mastoid, a chronic osteitis. In neither tissue could any evidence be found that would justify even a possible diagnosis of syphilis.

A spinal puncture was done on October 10, 1914, and the fluid was clear and under normal pressure. The Wassermann reaction with this fluid was negative; the globulin was not increased but there were reducing substances present. On this date the blood also gave a negative Wassermann reaction.

There still remained some doubt, Dr. Hartwell said, as to whether the decompressive operation or the administration of the mercury and iodide was the cause of the improvement that had taken place. The fact that the brain protruded through the openings in the skull seemed to indicate that there was still intracranial tension, and there was even a possibility of a latent abscess. Further observation of the case would probably solve these two questions, and the speaker said he hoped to be able to report further developments at some future date.

#### SEPARATION OF THE LOWER FEMORAL EPIPHYSIS

DR. FRANK S. MATHEWS presented a little boy who was brought to St. Mary's Hospital for Children two months ago, with the history that two months previous to that date he had met with an injury, sustaining a fracture of the left tibia and fibula, together with a separation and displacement of the lower femoral epiphysis. The fractures had apparently been recognized at the time of the injury and satisfactorily treated, but the separation of the epiphysis had been overlooked, and

the epiphysis had firmly united with the front of the shaft of the femur.

Dr. Mathews said that in spite of some compunctions about operating after the lapse of two months, he made an external incision and cut away the surrounding callus, which was quite as firm as normal bone, and then, with considerable effort, he was able to pry the displaced epiphysis over the end of the shaft. During the first few days following the operation the epiphysis was retained in place by keeping the knee in a strongly flexed position, and then straightened.

In several cases of this injury that were on record there was apparently no arrest of growth. In one of these, as in this case, the operation was done about two months after the injury. In another case the replacement was made immediately, but resulted in one inch shortening.

In reply to a question, Dr. Mathews said he had been able to draw the epiphysis into its proper position in this case by hard prying and flexing the knee. This rendered the use of spiking unnecessary, and also obviated the possibility of injury to the knee-joint.

#### FIBROSARCOMA OF THE LEFT AUDITORY NERVE: EXTIRPATION (1908)

DR. WILLY MEYER presented a woman, twenty-eight years old, who was referred to him by Dr. George W. Jacoby in January, 1908, with all the symptoms of a tumor in the cerebellopontine angle, with staggering gait and advanced optic neuritis. Both the left facial and left acoustic nerves were involved.

At the operation, which was done at the German Hospital on January 29, 1908, with the patient in the prone position and under general anæsthesia, the brain was exposed through a large horseshoe-shaped flap over the occiput: the entire os occipitale was removed, the longitudinal sinus was tied and divided, and both cerebellar hemispheres exposed by turning down a heart-shaped flap of the dura mater. With a brain-lifter well in place, a tumor, about the size of a bean, was found and successfully removed. The patient made a good recovery from the operation, but was kept under observation in the hospital for four months. Her gait and eyesight gradually improved, and after two and a half months she was able to count fingers throughout the entire length of the ward.

This patient was originally presented at a meeting of this Society in March, 1908 (*ANNALS OF SURGERY*, vol. xlviii, p. 309), under the title of "Craniotomy for Tumor of the Acoustic Nerve." When she was shown subsequently, in January, 1909 (*ANNALS OF SURGERY*,

## CYST OF THE BRAIN

vol. xlix, p. 552), she was able to read and write, do embroidering and housework, and could walk in a straight line. There was at that time a slight facial paresis and, of course, deafness on the affected side. At the present time, almost seven years after the operation, the patient showed no signs of a recurrence and was in excellent condition. She was able to read and write and do her housework, travelled about on the cars unassisted and had again become a useful member of society. Her eyesight, which was almost *nil* before the operation, had improved very much, although a slight blur still persisted.

This operation, Dr. Meyer said, was the first time he had resorted to Dawbarn's sequestration method for controlling hemorrhage, with excellent results. This patient now had a very large decompression in the occipital region. Pathologically, the tumor proved to be a fibrosarcoma.

## OSTEOPLASTIC RESECTION OF THE SKULL FOR INTRACRANIAL HEMORRHAGE

DR. MEYER presented a young man who came under his care in the summer of 1906—eight years ago—with the history that while riding horseback he had been thrown, striking over the right temporal region. He was picked up unconscious and carried home, where he was treated for concussion for forty-eight hours; then, focal symptoms developing, he was brought to the hospital, where further observation made it clear that an intracranial hemorrhage had taken place. The pulse had gradually fallen to 58 per minute and there were evidences of beginning facial palsy.

At the operation, which was done in June, 1906, a horseshoe-shaped osteoplastic flap was turned down over the right temple, and a large blood clot was found epidurally, which was carefully removed. The source of the bleeding could not be made out, but it was evidently a branch of the meningeal artery.

The patient made an uninterrupted recovery, and had remained entirely well since the operation.

## CYST OF THE BRAIN DUE TO SHOT-WOUND: JACKSONIAN EPILEPSY: CRANIOTOMY: CURED

DR. MEYER presented a man, thirty-seven years old, who, in 1898 while abroad, was shot in the right temporal region. Following the injury the bullet was located by the X-ray in the right frontal lobe and he was advised to leave it undisturbed. He remained perfectly well until 1911, thirteen years after the injury, when he was suddenly seized with an epileptic attack, evidently Jacksonian in type. A few days later he



## NEW YORK SURGICAL SOCIETY

had a second attack, followed by two others in the course of one month. These attacks were so severe in character that the patient was at times totally incapacitated and he was removed to the hospital, where the bullet was again located with the X-ray and an operation was advised, a cyst of the brain being suspected.

Operation: On turning down the osteoplastic flap there was free hemorrhage, and a number of fragments of the bullet were found in the soft tissues. There was no trace, however, of the bullet itself and no powder marks on the bone. As the brain was not pulsating, a puncture was made near the base, where there seemed to be a scar on the dura mater: clear fluid was obtained, and immediately the brain began to pulsate. An incision was then made through the thickened dura, allowing a large quantity of clear fluid to escape. Palpation with the finger disclosed the presence of a cavity, and upon enlarging the incision and inserting retractors, the cavity could be inspected, showing the irregular brain outline, and at a depth of about two inches the finger came in contact with the bullet. It was extracted with difficulty; some brain tissue followed. There was pronounced hemorrhage, which was promptly checked by a tamponade. The wound was drained, and the patient made a rapid recovery, leaving the hospital twelve days after the operation. During the next twelve months he had three further epileptic attacks, one in 1911, and two in 1912. For the last two years he had been entirely well and able to attend to his business.

Dr. Meyer said he did not use an elastic band around the head for hæmostasis. In making the incision through the soft parts the hemorrhage was usually slight, as he now always employed Dawbarn's sequestration method. The bleeding vessels were caught with forceps, which were left in place until the completion of the brain operation. The holes in the bone were made with the help of Doyen's and Hudson's drills, and the bone then divided with the Gigli saw. His average time for forming the bone flap was from twenty to thirty minutes.

DR. CHARLES H. PECK said he had shown a somewhat similar case a number of years ago where epilepsy developed eleven years after a shot-wound of the head, the bullet passing upward through the roof of the mouth, and finally resting underneath the scalp, where it could be easily felt. Several months after the onset of the Jacksonian epilepsy an operation was done, which uncovered a cyst of the frontal lobe, about the size of a pigeon's egg, and evidently in the track of the bullet. With the evacuation of the cyst and the relief of the pressure the patient eventually made a complete recovery, although there were a few convulsions shortly after the operation.



## SEPTIC BRONCHIECTASIS

### EXTIRPATION OF THE RIGHT LOWER PULMONARY LOBE FOR SEPTIC BRONCHIECTASIS

DR. HOWARD LILIENTHAL presented a boy, four and a half years old, who had been referred to him by Dr. Sidney Yankauer. The patient was shown at this time to demonstrate the final result, as the unfinished case had already been reported at the last meeting of the American Surgical Association and was published in the *ANNALS OF SURGERY* in June, 1914.

When the boy was two and a half years old he aspirated some food, and bronchiectasis of the right lower pulmonary lobe had followed, with increasing exhaustion from cough and sepsis. Dr. Yankauer had succeeded in removing much of the foreign matter with the aid of the bronchoscope, but still the cough and sepsis were unrelieved.

On February 27, 1914, the patient was operated on at Mt. Sinai Hospital under ether administered by the intrapharyngeal method by Dr. Branower. An intercostal incision along the entire lower border of the seventh rib was made, and through the wide opening secured by retraction of the ribs an excellent view of the intrathoracic contents was obtained. The upper lobes were normal in appearance and motion, the lower lobe was liver-colored and tense, and adherent to the diaphragm and chest wall. It was peeled loose, and the stump at the hilum, after crushing with forceps, was secured by a transfixion ligature of chromicized catgut, and the wound closed with gauze drainage. Seventeen days after the operation the stump came away. There was no leakage of air and the phenomenon causing the greatest alarm during the three months of convalescence was tachycardia.

At the present time the patient appeared to be entirely well, and his body was normally developed and symmetrical. The technic employed in this case, Dr. Lilienthal said, was necessary because the patient's poor condition demanded haste. He emphasized the importance of bronchoscopy whenever an operation upon the lung was contemplated.

DR. FRANZ J. A. TOREK said Dr. Lilienthal did not mention one important point in the technic of this operation, namely, that of leaving a small portion of the lung attached to the pedicle. When this is not done, the bronchus is apt to slip back into the mediastinum and cause mediastinal emphysema, if the ligature fails to hold.

DR. WILLY MEYER said there were a number of interesting points in connection with this case: one was the employment of pharyngeal anaesthesia.

In these cases not infrequently the adhesions rendered differential

## NEW YORK SURGICAL SOCIETY

pressure unnecessary: that is, we could sometimes get along without it, and personally he had done a resection of the lung lately without resorting to it. The danger mentioned by Dr. Torek, namely, the escape of air into the mediastinum, with fatal results, has often been seen. Yet, in reviewing excision of lobes of the lung for bronchiectasis and tumor, it was surprising that so many patients had recovered. Dr. Meyer said he was, in cases of pneumectomy, in favor of closing the principal part of the wound and then inserting a drain into one corner, or he sutured the entire wound and inserted a drain through a special intercostal incision. Post-operative acute pneumothorax was avoided by keeping the patient under differential pressure for from twelve to fifteen hours. He asked Dr. Lilienthal whether he had first ligated the blood-vessels accompanying the bronchus or crushed them with the latter. In his first case of bronchiectasis operated on by means of pneumectomy where the blood-vessels were tied and divided and then the stump crushed while the patient was kept under positive differential pressure, sudden death occurred. There had evidently been great stress on the right heart by the positive pressure, which besides might have been dispensed with, as there were many adhesions present.

DR. SIDNEY YANKAUER said that in view of the few recoveries that had been reported after resection of the lung, this case was very interesting from a surgical stand-point, but it was also interesting from the bronchoscopic side and the relationship of foreign bodies in the lung to bronchiectasis cavities. In the statistics of such cases, the number in which foreign bodies have been found was negligible, and in his own experience he had found foreign bodies in about one-third of the cases that he had examined.

The case presented by Dr. Lilienthal clearly illustrated what might happen: the parents of this child gave a history of the inhalation of a foreign body, and the general practitioner who saw the case directly afterwards made a diagnosis of laryngeal spasm. Subsequently, diphtheria was suspected, and later Dr. Yankauer succeeded in removing some particles of food from the right bronchus. The case emphasized the importance of early bronchoscopy in every suspicious case of this kind, and, furthermore, he did not hesitate to say that every case of bronchiectasis should be subjected to a bronchoscopic examination at as early a stage as possible.

DR. N. W. GREEN, in connection with the statement made by Dr. Torek that it was very important to crush the bronchus in order to avoid a subsequent emphysema, said he wished to refer to some experimental

## SEPTIC BRONCHIECTASIS

work in lung resection, which he did some years ago, in which, in one instance, he got a very good result by cutting off the base, first putting a strong suture immediately under the pleura, and drawing it around the vessels and bronchus, then sewing the pleura and lung tissue remaining over the stumps of bronchus and vessels.

After the removal of a portion of the lung tissue, we either had to deal with a clean wound or a suppurative condition; if the former, we could feel warranted in closing up the chest cavity and watching developments, whereas in the face of suppuration we should employ drainage from the start.

DR. LILIENTHAL, in closing, replying to Dr. Torek, said he did not leave any piece of lung tissue in this case, as the parts were matted together by adhesions and after the crushing and ligation, the structures of the hilum could not easily recede. He feared the occurrence of a bronchial fistula, but this did not happen. He did not think that in this case the stump could have slipped into the mediastinum on account of the presence of the adhesions, and he did not consider it necessary to leave a piece of lung tissue if the vessels were ligated *en masse*. Dr. Carrel had told him personally that his method was to crush and tie off the hilum, and then cauterize the stump with carbolic acid—a method he had adopted after seeing Dr. Lilienthal treat the stump of an excised appendix in this manner.

The septic and non-septic cases, the speaker said, were entirely different, and required different treatment. In a septic case, drainage of some sort was imperative, while in a perfectly clean case the question arose whether air should be left in the thoracic cavity or whether fluid should be put in. In his own case, he used saline solution. Dr. Mackenzie of Portland, Oregon, tried paraffin oil, which, while not an antiseptic, was not a good medium for bacteria.

In the case he had shown, Dr. Lilienthal said, it was known that there were adhesions, and differential pressure was not considered necessary. He did not ligate any vessels because the pedicle was a solid mass of inflammatory tissue. He was inclined to agree with Dr. Yankauer that early bronchoscopy might help clear up many cases of supposed bronchiectasis of obscure origin. He recalled a case seen at Bellevue Hospital two years ago where there was no history of foreign body, and an operation was contemplated. An X-ray was taken which showed a collar-button in the bronchus. Dr. Yankauer removed it with a great deal of difficulty, and the child, after an illness that dated back three months, was well in three days.

## NEW YORK SURGICAL SOCIETY

### ENDOTHELIOMA OF THE BRAIN THREE YEARS AFTER OPERATION

DR. JAMES H. KENYON presented a woman, twenty-five years old, a patient of Dr. B. B. Ransom, Jr., of Maplewood, N. J., who was referred to Dr. Kenyon by Dr. M. Allen Starr. She was admitted to the New York Hospital on June 24, 1911, with the history that previous to the onset of her present illness she had always been well and strong. There was no history of any injury to the head. About five years before her admission to the hospital her husband noticed that she was slow in answering questions, and about the same time he observed a small lump on the top of her head, anterior to the vertex. This lump slowly increased in size; the patient's response to questions became more hesitating; she was forgetful and failed to complete her sentences. About four months before her admission she began to suffer from intermittent attacks of severe frontal headache; her vision became impaired, and two weeks later diplopia was noticed. During the three weeks before admission the most marked symptoms were the impaired vision, diplopia and frequent attacks of vomiting.

Examination: The patient was fairly well nourished. Over the midline of the vertex in the frontal region there was a hard, non-tender swelling, about an inch and a half in diameter. The overlying skin was normal.

Eyes: The pupils were equal and reacted to light. There was double choked disk; no hemorrhages.

The reflexes were equal on both sides, but exaggerated. Sensation normal. The patient was slow to respond to questions; she was listless and did not remember what she did nor what was told her.

Operation, June 26, 1911: Under gas and ether anæsthesia, a crucial incision was made over the swelling on the vertex and the soft parts pushed aside. With the electric motor and the burr drill, nine holes were made in the normal skull about half an inch distant from the swelling. These holes were measured, the three anterior being 10 mm.; the others varied from 4 to 9 mm. The circular saw, protected with a washer, was used to cut the bone between the various holes; in two places this cut was across the median line, and therefore crossed the longitudinal sinus. A few light taps with the osteotome cracked the thin, uncut portion of the inner table, and the piece of bone was lifted out.

The swelling revealed by the removal of the bone was over the midline, but somewhat more on the left side than on the right. The ragged surface of the tumor bled quite profusely, but this was readily controlled by firm pressure with gauze thickly impregnated with vasa-

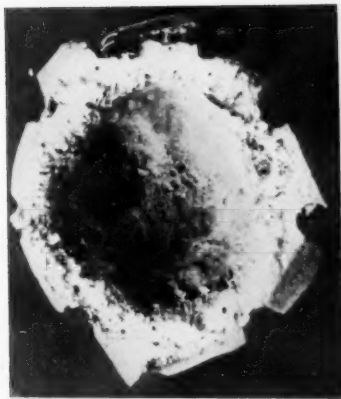
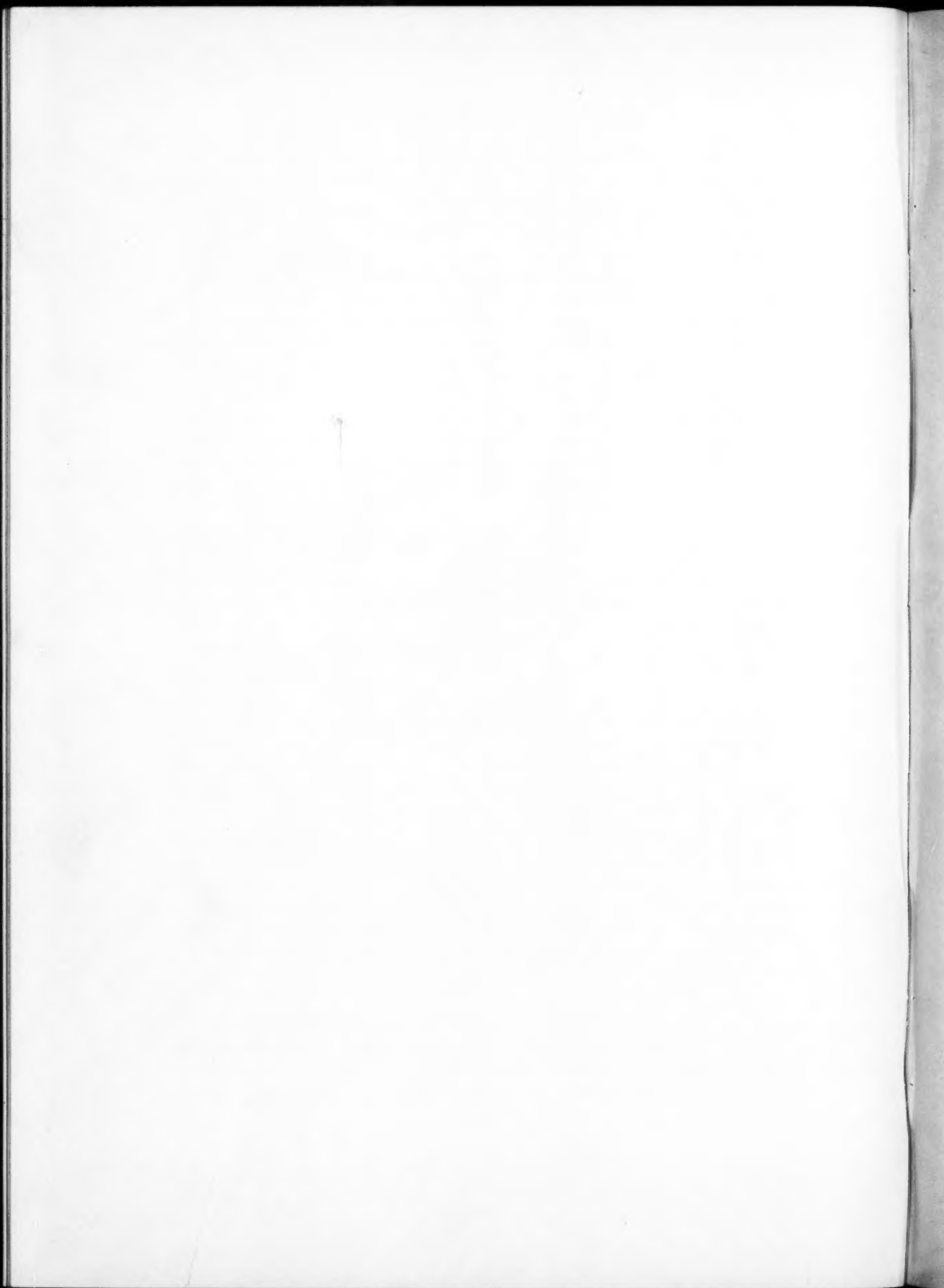


FIG. 1.—Mrs. A. K. W. Endothelioma of the brain. Piece of bone removed from the vertex,  $2\frac{1}{2}$  inches by  $2\frac{3}{4}$  inches. Note the thickness, from 4 to 10 millimetres, also the marked erosion on the inner or cranial surface.





## OBSERVATIONS UPON CEREBRAL SURGERY

line. There was no injury to the dura or the sinus from the saw. The longitudinal sinus, which extended along one edge of the swelling, was ligated in two places, about an inch and a quarter apart, and cut. Several large vessels in the dura at the periphery of the mass were ligated. A more or less circular cut was made in the dura around the swelling. As it was decided to do the operation in two stages, the soft parts were sutured in place and a firm dressing applied.

One week later, without anaesthesia, all the sutures were removed and the soft parts opened. With a spoon and small artist's spatula, bent to a curve and heated to a dull red in a Bunsen flame, a large amount of the soft, pulpy mass was removed. The actual cautery and the hot air blast were used to control the hemorrhage. The index finger in the wound could be freely swept in every direction, showing an absence of almost the entire frontal lobe. Vaseline gauze was firmly packed in the cavity and the soft parts partially sutured. A hypodermoclysis was slowly running throughout the entire procedure. The patient was perfectly conscious; she was able to answer questions and did not complain of pain.

The patient made a good convalescence, the temperature never going above  $101^{\circ}$ , and she was able to leave the hospital twenty-two days after the first operation. Her physical condition was good, but she was very hysterical, talking and laughing, and had various delusions. At the time of her discharge from the hospital the wound showed a large, soft, protruding mass, more or less necrotic. About two months later this swelling had disappeared, and the wound had healed. There was very slight bulging.

Her general condition, physical and mental, rapidly improved, and a month later she was practically well. She had always been fond of music, and was even more appreciative of it after the operation than before. In July, 1914, she apparently showed the effects of over-indulgence in social duties during the previous winter season, and was obliged to leave home for a time for a rest. At the present time, however (October, 1914), she is in excellent condition, both mentally and physically. Her memory is good, and she is free from headache. The area over the vertex from which the bone was removed is firm, with the same curvature as the rest of the head. It pulsates freely.

## OBSERVATIONS UPON CEREBRAL SURGERY

DR. JAMES H. KENYON read a paper with the above title, for which see page 17.

DR. CHARLES A. ELSBERG said that in about 400 craniotomies he

had used burrs and fraises in about one-third of the cases. Most of these operations were done a number of years ago, and the dura had been injured at least in a dozen operations. This led him to adopt what he considered a simpler and safer method, the making of drill holes with the ordinary trephine and dividing the flap with cutting forceps. One part of the circumference was always cut obliquely with the Gigli saw, so that when the flap was returned into place it could not rest on the dura. From the time he had used this method he had never injured the dura, and therefore considered the method a very good one. Still the motor and drill is undoubtedly useful in many cases where the skull is very thick and will require great manual labor to cut the bone with forceps. He also believed that the surgeon should use that instrument to which he is accustomed and therefore others might do as well or better with the motor and drill as he had done with the trephine and cutting forceps.

DR. LILIENTHAL said he had had the opportunity of seeing the late Dr. Hartley and Dr. Kenyon use these motor drills on the skull, and the work accomplished with this machine was certainly very rapid and beautiful. In certain cases, the saw was of great service, but for decompression purposes he believed that the chisel and gouge, if properly used, were not only the safest but the most satisfactory instruments for opening the skull. By drilling a number of holes first and then cutting with the gouge held tangentially there was no danger of injuring the dura. He had been able to open the skull, do an operation for brain cyst, and close the wound—all in twenty minutes, and as far as speed and safety were concerned, he thought this method compared favorably with any other. The possibility of concussion could be practically disregarded when the gouge was held tangentially.

The value of the sequestration method of producing temporary anæmia could easily be demonstrated by the sphygmomanometer, which showed that it reduced the blood-pressure as much as sixty points. Personally, he resorted to it in all cases in which severe hemorrhage was expected.

DR. KENYON, in closing, replying to a question by Dr. William C. Lusk as to whether this instrument, in skilled hands, had ever been known to injure the dura, said he could recall about half a dozen cases where the dura was slightly nicked, perhaps for a distance of one-quarter or one-half inch. He only remembered two instances where the underlying cortex was nicked. In none of these cases did any serious result follow, and they all occurred during his earlier experience with the instrument, when an insufficient number of holes were made in the

## PAPILLOMATOSIS OF THE BLADDER

skull and therefore the exact thickness of bone to be cut was not accurately known.

As to concussion, they had found that if the osteotome were held tangentially, as suggested by Dr. Lilienthal, the blows produced no effect on the blood-pressure. The sequestration method of anæmia, to which some of the speakers referred, seemed to be a good thing, although he had never used it personally. He was not in favor of hypodermoclysis as a routine measure in these operations; in fact, this was the only case in which he had used it. This was a second-stage operation and the patient was not under the influence of an anæsthetic.

*Stated Meeting, held at the New York Academy of Medicine, October 28, 1914*

The President, DR. FREDERIC KAMMERER, in the Chair

### PAPILLOMATOSIS OF THE BLADDER: CARCINOMA IN SUPRAPUBIC SCAR

DR. EDWIN BEER presented a man, seventy years old, who gave a history of intermittent hæmaturia dating back twenty years. Subsequently pain developed, and in December, 1905, a pedunculated papilloma of the bladder was removed through a transvesical incision. The growth was submitted to Dr. F. S. Mandlebaum, who pronounced it a papillary carcinoma. Within a year he developed a stone in the bladder, of which he was relieved by litholapaxy in November, 1906.

When Dr. Beer first saw the patient, in July, 1911, he had extensive papillomatous growths in the bladder which were rapidly reduced in size by various forms of the high frequency current, but the improvement was only temporary, and after a few months' interruption of the treatment the bladder was again filled with numerous papillomata, so that the electrode, when it was introduced, travelled three inches through tumor tissue before it struck the bladder wall. Specimens of these growths were repeatedly removed, and on five different occasions they were submitted to the pathologist and were invariably pronounced simple papilloma.

As the high frequency treatment had proven ineffectual and too tedious, the bladder was re-opened through the old scar in January, 1913, and a large amount of tumor tissue removed. This was also pronounced simple papilloma, without infiltration of the bladder wall.

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At this time radium was given a trial, but the specimen was not sufficiently powerful and practically gave no result and the bladder was allowed to close.

Following this operation there was a rapid recurrence of the vesical growths. The patient suffered much pain, necessitating the use of opiates. His kidneys gradually refused to act and he became oedematous up to the umbilicus. There was great frequency of urination, with excruciating pain, and his condition became so pitiable that on November 29, 1913, Dr. Beer did a suprapubic cystotomy and resected the anterior wall of the bladder, to which large tumor masses were adherent. At the same time he tied off some of the smaller growths and cauterized others with the Paquelin cautery, also cauterizing all suspicious areas of the bladder wall.<sup>1</sup> After a rather stormy convalescence the patient recovered. Subsequently, three tiny papillomata in the scar in the anterior bladder wall were removed without any difficulty with the high frequency current. The patient was now fairly comfortable and remained so until the summer of 1914, when he developed a nodule in the suprapubic scar. About three weeks ago a section of this was excised and submitted to Dr. Mandlebaum, who pronounced it carcinoma. The patient was receiving X-ray treatment at present.

### FECAL FISTULA: NEW METHOD OF CLOSURE

DR. BEER presented a man, sixty years old, in order to illustrate a new and simple method which he had devised for the closure of a fecal fistula. The patient was operated on in October, 1913, when the first stage of the Mikulicz operation for carcinoma of the descending colon and sigmoid flexure was done. Six days later the protruding mass was cut off flush with the skin, and a week after this a remaining spur was crushed.

On September 14, 1914, about a year after the original operation, the following procedure was successfully carried out to close the resulting fecal fistula. The idea underlying the operation is the extra-peritoneal closure of the stoma and the immediate covering of the suture line with skin and fat flaps taken from either side of the stoma. By this means if a leakage occurs its tract becomes circuitous and by virtue of that fact it is very liable to close spontaneously.

This procedure can readily be carried out under local anæsthesia and is very evidently much simpler than the usual methods.

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<sup>1</sup> The extent of the growths can be best appreciated from the fact that the cautery was used for 40 minutes within the bladder.



## NON-ROTATION OF COLON AND ULCER OF STOMACH

### PERINEPHRIC ABSCESS, DUE TO STONE IN THE KIDNEY, COMMUNICATING WITH KIDNEY PELVIS

DR. BEER presented a woman sixty-three years old, who was admitted to the Mt. Sinai Hospital on September 20, 1914, with the history of dull pain in the left lumbar region dating back for five years, and that for two weeks prior to her admission she had suffered from fever and chills. She gave no urinary symptoms and her temperature was normal.

The case at first was not regarded as of surgical interest, but upon examination a small, fluctuating tumor was located in the left lumbar region, which upon aspiration proved to be an abscess containing pus in which the bacillus proteus was found. The cystoscope showed that the left ureter was obstructed while the right kidney secreted normal urine. An X-ray gave negative findings.

Upon operation, which was done on September 26, 1914, Dr. Beer found a superficial abscess leading down to the kidney, which was surrounded by dense, perinephric fat. The kidney pelvis contained numerous stones. The specimen shows the tract leading from the pelvis through the parenchyma.

### NON-ROTATION OF THE COLON AND ULCER OF THE STOMACH

DR. WILLIAM A. DOWNES presented a man forty years old, who was admitted to the hospital on June 4, 1914, complaining of pain in the upper right abdomen. His past history was that he had typhoid fever at the age of twelve, and that for the past five years he had what he termed attacks of pain in the stomach.

His present illness began seven weeks ago, when he vomited and felt weak and faint. A few hours later he had severe, cramp-like pain in the abdomen, radiating to the back. The vomitus contained no blood. Attacks similar to this one were repeated once or twice weekly and they apparently bore no definite relationship to the taking of food. He had lost 25 pounds in weight.

Examination of the abdomen showed no rigidity, but slight tenderness in the upper right quadrant. At the operation, which was done on June 5, 1914, the stomach was found to be dilated, but normal in location. On the lesser curvature, near the pylorus, there was a dense area of scar tissue, the result of a cicatrizing ulcer, and the entire stomach wall was somewhat thickened. The ascending and descending portions of the colon were adherent to each other. The colon with the omentum lay entirely to the left of the median line; the appendix and cæcum were in the left iliac fossa and the duodenum intraperitoneal.

The operation consisted of an anterior gastro-enterostomy with a

loop of about eight inches—a longer loop of intestine was not necessary as the intestine did not have to be carried over the colon and omentum—the anastomosis lay entirely to the right of these structures. The patient made a good recovery and was discharged on June 18, 1914.

DR. LEON T. LEWALD showed a series of radiographic plates illustrating the abnormal position of the colon in the case presented by Dr. Downes (Fig. 1). The case illustrated particularly well the necessity of the röntgenologist making a *complete* examination of the gastro-intestinal tract in each case referred to him for examination. It had so happened that in this case and in two other cases which Dr. LeWald had seen, the Röntgen examination had been *limited* to the stomach, and in all three cases there had been non-rotation of the colon, left-sided situation of the appendix and cæcum, and an abnormal position of the duodenum. In the first case another röntgenologist, Dr. L. G. Cole, had made a diagnosis of a pathological condition of the duodenum requiring surgical intervention. A subsequent examination was made by Dr. LeWald, who examined not only the stomach and duodenum *but the colon as well*. Non-rotation was found, and it then became evident that the peculiar appearance of the duodenum was due to the non-rotation of the colon and hence lost its significance as an indication for surgical intervention. In the second case a röntgenological examination of the stomach region alone had been made at another hospital and terminated as soon as a peculiarity of the duodenum was observed. A diagnosis of dilated duodenum was made and the abdomen opened. Non-rotation was recognized and the abdomen closed without further procedure. In the case presented by Dr. Downes the examination had *purposely* been limited on account of urgent symptoms of gastric dilatation and retention of the bismuth meal. Enough of the bismuth, however, had gone into the first part of the colon to indicate that there was *apparently* an abnormality of the colon. This fact was incorporated in the record of the Röntgen findings, but failed to reach Dr. Downes' attention, so that he independently noted the abnormality of the colon on the operating table as he was searching for the jejunum in order to perform a gastrojejunostomy. As he stated, owing to the abnormality, one might easily have seized the terminal loop of the ileum and considered it the first loop of the jejunum, as it presented itself on the *left* side, while there was no true duodenojejunal angle present, as is the rule in these cases, for the duodenum does *not* pass behind the stomach, but is found passing straight out to the right and passes then downward and becomes jejunum without there being any external appearance to indicate the junction. Dr. Downes' case is the first case

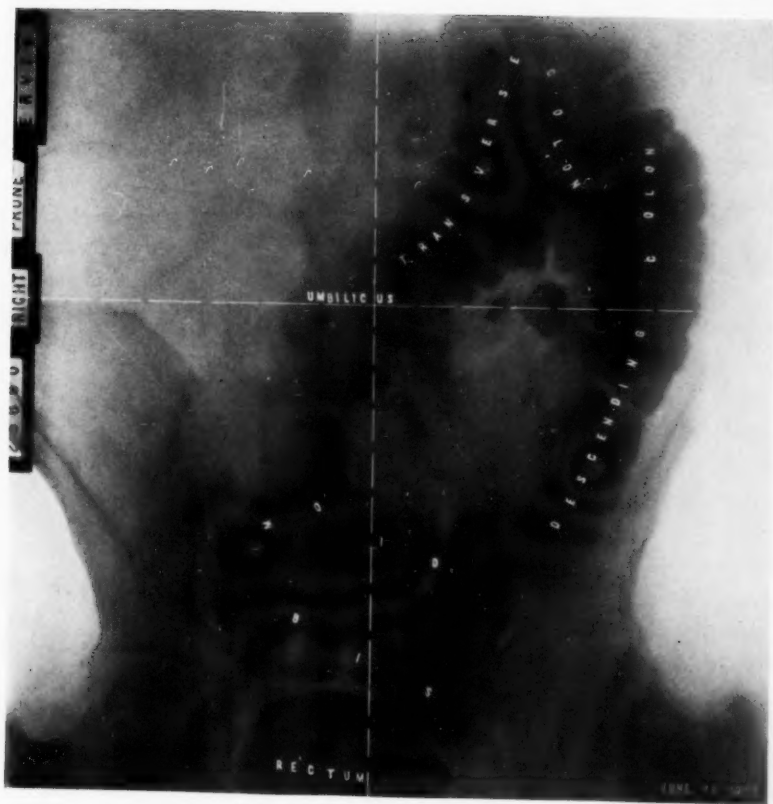
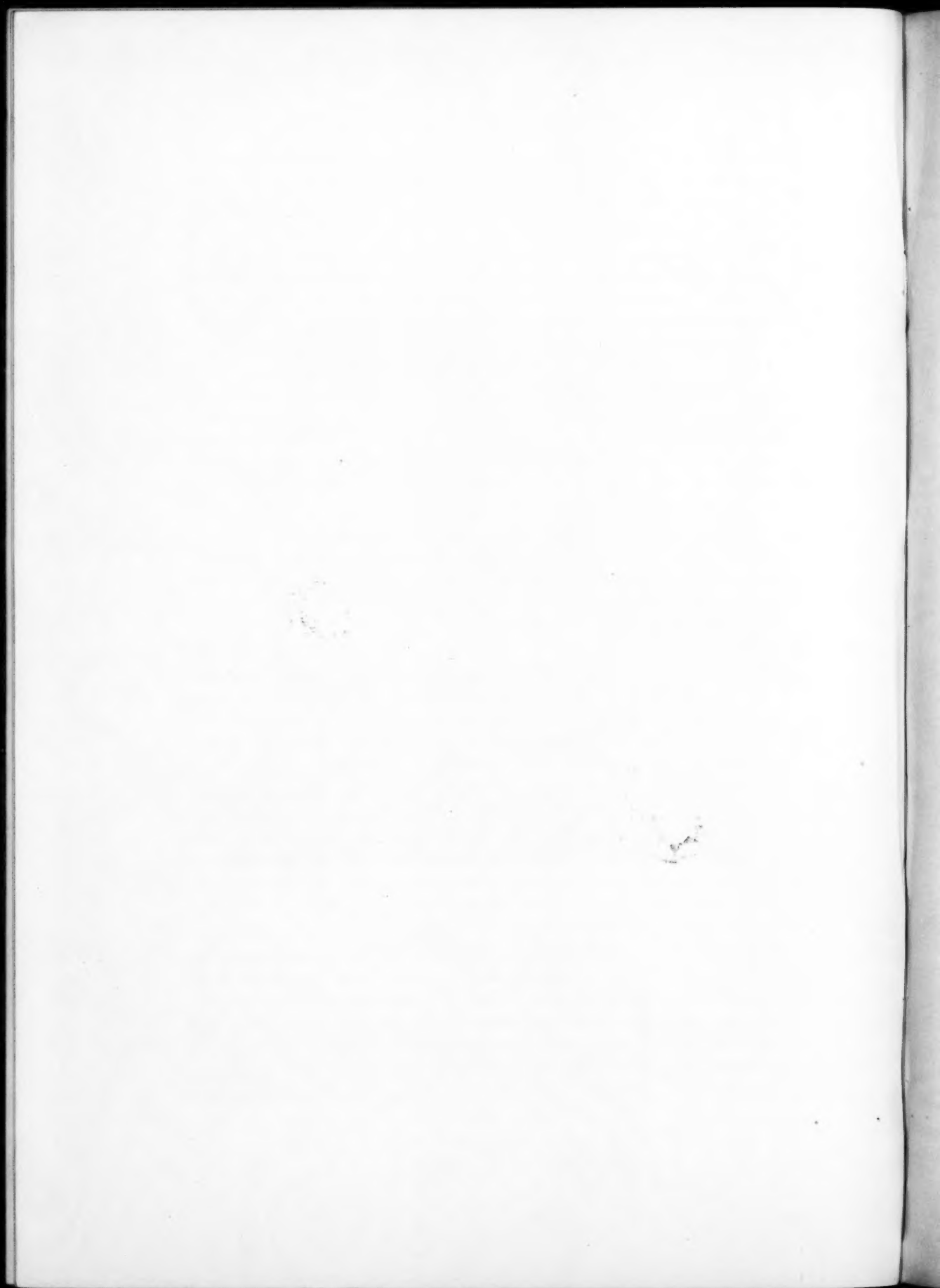


FIG. 1.—Non-rotation of the colon.



## INTESTINAL OBSTRUCTION DUE TO ILIAC SPASM

in which Dr. LeWald had known of a gastro-enterostomy having been performed in a case of non-rotation or transposition of the viscera. In the *complete* transposition cases there would be little chance for error in recognizing any portion of the intestine unless perchance one should encounter a case of transposition complicated by a non-rotation of the colon in the *same* individual. In such a case, the double anomaly would bring the appendix back on the right side and there would be an absence of any part of the colon on the *left* side.

## INTESTINAL OBSTRUCTION DUE TO ILIAC SPASM

DR. WILLY MEYER presented a boy, nine years old, who was operated on at the German Hospital on January 21, 1914, for acute appendicitis. A gangrenous appendix was found, necessitating drainage. When Dr. Meyer subsequently took the service, the wound had almost closed, but the boy's bowels were not moving regularly, and one morning he had a severe attack of abdominal pain, with vomiting; no evacuations. The house surgeon had already given two doses of castor oil, without result, and when Dr. Meyer saw the patient he ordered suppositories of aqueous extract of laudanum and extract of belladonna, which he had seen act favorably in these cases. A number of hours later the boy had a thorough evacuation of the bowels. This treatment was repeated several times with success, but when the medication was stopped the symptoms of intestinal obstruction recurred. Peristaltic action of the bowels could be clearly seen and loud gurgling noises heard. As pain and vomiting persisted, a second operation was decided on.

Upon opening the abdomen below the umbilicus, many adhesions and bands were encountered, but none of the latter were of sufficient strength to produce compression of the bowel. The incision was thereupon extended above the umbilicus, and there, at the uppermost portion of the jejunum, was a much distended segment of gut, and tracing this downward they found that it led into a section of intestine, perhaps two feet long, which was in a state of complete collapse. Upon manipulating this it slowly began to fill with air and gradually assumed its normal appearance. The entire gut was then traced down to the cæcum without finding any other abnormality. The abdomen was thereupon closed, and as a possible preventive against further adhesions, Dr. Meyer said he adopted the application to the abdomen of superheated air, as recommended by a colleague in Philadelphia not long ago. In this case he used a cradle with a double row of electric lights inside, which was applied to the abdomen over blankets for about six hours; it was then removed for a time and later re-applied, this being done three or four



times in the course of twenty-four hours at lengthening intervals. Of course, he could not say positively that this prevented the formation of post-operative adhesions, but in this case, at least, the patient's bowels moved soon without assistance. The method had been recommended as a very efficient one for producing early evacuation of the bowels after abdominal section. The speaker said he had used this method in another case to satisfaction and that he expected to continue to use it, as he believed it had some effect to prevent the formation of adhesions.

In this particular case, Dr. Meyer said, the cause of the intestinal obstruction, so far as he had been able to discover, was very unusual. The ileus could not be traced to an actual mechanical obstruction nor could it be termed a paralytic ileus. There was complete collapse of about twenty-four inches of intestine, due likely to a pronounced spasm; upon manipulation the air re-entered this section of gut, which thereupon resumed its normal function. The speaker said that a similar case had come under his observation on a former occasion.

DR. KAMMERER asked Dr. Meyer whether his manipulations possibly might have loosened some adhesions. The empty section of gut was perhaps only an expression of a twist or other mechanical obstruction which was suddenly relieved. Personally, he had never seen a spastic condition of the gut such as that described by Dr. Meyer.

DR. MEYER said that there were, of course, a certain number of adhesions about the cæcum, but nothing like a groove in the gut due to a band that would have accounted for the obstruction. When he came down upon the distended gut in the uppermost part of the intestinal tract, he confidently expected to find a mechanical obstruction lower down, to account for it. But there was nothing of the kind. This boy had typical symptoms of obstruction, with vomiting, pointing to the seat of trouble in the upper intestines.

#### RESECTION OF THE LUNG FOR BRONCHIECTASIS

DR. WILLY MEYER presented a woman, fifty-seven years old, upon whom he had operated in May, 1914, for bronchiectasis. The speaker thought a clear distinction should be made between an excision of the lung, such as that described by Dr. Lilienthal at the previous meeting of the Society, and a resection of the lung, as was done in this case. This patient was first operated on at a Brooklyn Hospital in January, 1910, for an empyema following acute pneumonia. In the course of the following years Dr. R. W. Westbrook of Brooklyn performed a number of operations, some far reaching, to close the empyema fistula. At last a wide thoracoplasty was done and a lung focus laid open. Through

## RESECTION OF THE LUNG FOR BRONCHIECTASIS

the courtesy of Dr. Westbrook the case was referred to Dr. Meyer. On the left posterior chest wall there was a deeply indented scar, and in its depth lung tissue was exposed, with numerous open bronchi at its base. The condition was suggestive of the result of an old embolic septic pneumonia.

Operation: The patient was placed on her abdomen, and under general anæsthesia the wound was re-opened and portions of the fifth, sixth, seventh, eighth and ninth ribs resected, taking pains to leave the infected tissues untouched. The speaker said he entered the remnant of the pleural cavity above and below the open wound; having circumscribed the entire field and entered the pleural cavity the actual cautery was applied and the wound in the lung fully exposed. There were so many adhesions that differential pressure was unnecessary. His desire, Dr. Meyer said, was to extirpate the involved area, but the lower affected pulmonary lobe was so much a unit with the upper that this would have necessitated transverse division of the entire upper lobe, and as the patient's condition was not of the best, it was decided to do a resection. Two clamps were thereupon applied and the entire diseased portion excised. As the lobe was much contracted and somewhat atelectatic, its two sides were unequal and had to be closed separately, ligatures being placed around the bronchi and vessels. An inverted chromicized gut suture was then inserted, as in gastro-enterostomy. This having been done, he had to deal with two remnants of lung tissue closely attached to the bronchi, but separate, and these were stitched together with a running suture.

The patient made a good recovery as far as the first stage of the after-treatment was concerned. But early during the third week she developed a fever, evidently due to a localized pneumonic process. Active pressing gave rise to a slight hissing noise in the wound, showing that all bronchi were not entirely closed. This complication, the speaker thought, might perhaps have been avoided by a more thorough sterilization of the bronchial lumina with pure carbolic or active cautery. There were still three small openings leading down to the infected bronchi, but the patient's general condition had greatly improved since the operation; she had gained over twenty pounds in weight and there was comparatively little expectoration.

Dr. Meyer said he believed that the best treatment for these cases was extirpation, and he would resort to this whenever possible.

DR. WALTON MARTIN asked if this patient had suffered much from cough. It had been his experience that one of the most distressing symptoms was persistent cough as long as the fistula remained open.

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DR. MEYER replied that while this patient still suffered from a few distended and chronically inflamed bronchus divisions, her cough had almost disappeared and the discharge from the fistula had greatly decreased. At the present time she had perhaps three or four fits of coughing in the course of twenty-four hours, with very scant expectoration. There was apparently still a cavity formation in the first division of the bronchus.

### PERSISTENT EMBRYONAL TYPE OF LARGE INTESTINE

DR. H. BEECKMAN DELATOUR read a paper with the above title for which see page 74.

DR. LEWALD showed a series of radiographic plates illustrating the type of cases described by Dr. Delatour. Dr. LeWald had observed four cases of non-rotation of the colon röntgenographically and had also personally studied eight cases of complete transposition of the viscera. Therefore a left-sided appendix was possible from either one of these anomalies of development, and was of frequent enough occurrence to keep one always on the lookout for it. The position of the cæcum, and in many cases even the appendix itself, could be definitely determined prior to operation if a complete Röntgen ray examination of the digestive tract were made.

DR. BEER said that in connection with the interesting cases reported by Dr. Delatour he wished to call attention to another type of congenital deformity of the large bowel which he had had an opportunity to see. About nine years ago a three-days-old female child was brought to him with the history that the bowels had not moved. On inserting the finger into the rectum he found an obstruction about two and a half inches from the anus, where the bowel was contracted to such a degree that only a small silver probe could be introduced, even under guidance of the eye through a proctoscope. A laparotomy was done to relieve the obstruction, and he exposed a section of bowel that he supposed was the cæcum. An artificial anus was established, but the child continued to vomit and death occurred. At the autopsy the artificial anus was found to be low down in the ileum, and the entire colon was about the calibre of an adult ureter.

DR. WILLY MEYER referred to cases of non-rotation of the cæcum, to which Dr. Vosburgh called attention about two years ago. In some cases of appendicitis where we failed to locate the appendix through the usual rectus incision he thought it advisable that no time should be lost in abandoning the anterior incision and making an additional posterior incision. He recalled one interval operation in the hands of

#### PERSISTENT EMBRYONAL TYPE OF LARGE INTESTINE

another surgeon where a prolonged and futile search for the appendix through the anterior incision resulted in the death of the patient. It was better, under such conditions, to abandon the anterior incision without unnecessary delay, turn the patient on his left side with a sand-bag under the hip, and make a second incision posteriorly towards the kidney, when the appendix would usually come into view and could be removed without further trouble.

DR. DOWNES said that in the case he had shown at this meeting the ascending and descending limbs of the colon were bound together with a series of very firm adhesions.

DR. DELATOUR, in closing, said that in one of the illustrations he had shown, which was taken from Huntington's Anatomy, the cæcum was placed entirely to the left, yet the appendix was to the right. This might give rise to right-sided symptoms with a non-rotated large intestine.



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**SURGICAL DISEASES OF CHILDREN.** By SAMUEL W. KELLY, M.D., LL.D., Pædiatrist and Orthopædist, St. Luke's Hospital, Cleveland. Second Edition. E. B. Treat Company, New York, 1914.

This book, dedicated "to any hapless child, crippled, injured, ill, and to any doctor who sees and fain would help," is decidedly something more than a general surgery as applied to childhood. It actually deals with the peculiar physiological and pathological conditions which have to do with surgical diseases in children, and coördinates them with such surgical treatment as is applicable to the child. Besides its scientific quality, the book possesses the rare human appeal which the suffering child calls for.

Surgery has been written with the mind largely upon the adult patient. This book is different. The adult is considered only in the light of what he can do for the child, and in the light of the fact that "the child is father to the man." "With infants and young children a certain amount of 'mothering' seems to be a necessity. Without it they become apathetic and give up the fight for life." The author furthermore says, "An abundance of fresh air and sunlight should be provided. Because children's beds are small is no reason why more of them should be crowded into a ward. Too many people think any little corner will do for the child's bed. There is no class of patients who so promptly fade and languish when deprived of air and sunlight, and none will respond so quickly to their health-giving influence."

In discussing the treatment of tuberculous disease, inconsiderate surgical interference is interdicted, but when operation is determined upon, it is urged that it should be done with the most scrupulous thoroughness. Treatment in tuberculosis, it is shown, is much more conservative than it formerly was, but, when surgical interference is inaugurated, it is much more radical than formerly. Half-way measures are to be avoided; when operation is determined upon it should be complete.

The cerebrocranial topography, it is shown, is quite different from that in the adult. The fact that every surgeon knows how to put on a good plaster jacket, yet not every surgeon puts on a good plaster jacket, is brought out.

In appendicitis it is urged that early operation in all cases is the



## BOOK REVIEWS

safest line of treatment. The four principal conditions under which operation for appendicitis is done are described as (1) early in the attack when the disease is still confined to the appendix, (2) when abscess is formed but is limited by adhesions, (3) in the presence of general peritonitis or where abscess had recently escaped into the peritoneal cavity, and (4) in the intervals between exacerbations of chronic or recurrent attacks. This is a widely inclusive list of indications.

Perhaps there is too much medication in this book to suit the modern surgeon. Strychnia, ergot, hot coffee, and whiskey in shock are all mentioned. Styptic drugs, such as tannic and gallic acids, lead acetate, ergot, hamamelis, hydrastine, and stypticin, are mentioned in connection with hæmophilia, but transfusion of healthy blood is not. Cod-liver oil, creosote, guaiacol, arsenic, and syrup of iodide of iron are recommended in tuberculosis. Whiskey, strychnia, and quinine are recommended as stimulants in *cancrum oris*.

Before performing arthrectomy, the author says the limb should be "Esmarched"! The reviewer has struck what he had hoped were effective blows at the hydraheaded monster, "proper-name nomenclature"; but here it lifts its head again and flaunts itself more viciously than ever before, entwining now in its toils the name of Esmarch, and that honored name no longer a solid thing to conjure with as of yore, but transmuted into a verb—a squirming and inconstant verb—as though to call from his grave the peaceful master to twine himself around a leg and stop a bloody flux. Come let us up and at it, lest it return again, and lest we see the urethra otised, the vagina simsed, the female pelvis kellyed, calculi bigelowed, and not only the kinks of the bowels but broken bones as well smoothly and deftly laned out! Surgery has seen some bad business. We have sewed up in the abdomen such substantial objects as Pean clamps and Bull retractors—nouns, and bad enough—but pity the unhappy patient with a verb sewed into his insides, to give issue not to peans but rather to persuade him that his belly harbors a bull in a china shop.

The book was never written that could please all humors. This book of Dr. Kelly's should be gratefully received by the surgical world. It is surgically sound, and constitutes a much needed contribution to the literature of surgery. The surgeon who studies it will, in so doing, qualify himself just so much better to administer to that class of patients most needful of careful treatment. It is capable of making him more competent as the conservator of the child.

J. P. WARBASSE.

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**THE PRACTICE OF SURGERY.** By RUSSELL HOWARD, Surgeon, Poplar Hospital; Assistant Surgeon, London Hospital; Joint Lecturer on Surgery, and Teacher of Operative Surgery, London Hospital Medical School. 1227 pages, 8 colored plates and 523 illustrations in the text. J. B. Lippincott Company, Philadelphia. Edward Arnold, London, 1914.

This volume was written at the request of many past and present students of the London Hospital. The author has endeavored, as far as is possible in a text-book, to convey the surgical teaching of this medical school.

The book embraces thirty-seven chapters. It covers nearly the entire field of surgery, including brief accounts of the work of the orthopædic, the genito-urinary and the neurologic surgeons, the gynecologist, otologist, and the laryngologist. The book, accordingly, is comprehensive and affords an introduction into the rarer abnormalities and to curiosities as well as to the commoner diseases of surgery. Unsettled points of theory and practice are not discussed, though they are given appropriate mention.

No attempt has been made to take up surgical diseases in their order of interest, importance or frequency. From the didactic standpoint this is the weakest point in the work, as an equal emphasis is laid on each province and the student derives no definite hitching posts to assist his memory. The order of presentation of subjects corresponds to the classical method of first stating the principles of surgery and then discussing the various organs and systems in turn.

The book opens with a review of our present knowledge regarding infection, immunity and serum therapy. In view of the demands of our modern medical curriculum, this section seems out of place in a text-book of surgery, notwithstanding past traditions. The brevity of the section, furthermore, emphasizes its uselessness. A chapter on inflammation follows. The principles and methods of treatment referred to here are very good and correspond to the general excellence of the therapeutic advice offered throughout the work.

As the volume has been designed chiefly for undergraduate use, no attempt is made to detail operative technic. The appropriate operations are mentioned throughout, however, and usually sufficient description is included under each to afford the reader a fair idea of the steps taken. To the beginner the emphasis laid on asepsis in each section is of some importance. This should aid materially in the adoption of proper operating-room methods in post-graduate years.

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Though the modern operative treatment of acromegaly and other hypophysis diseases is now well recognized and offers some success, the author merely states that attempts at operation on the pituitary body have been made. A similar omission is again manifest in the treatment of spastic paralysis conditions. No reference is made to the recent operative work on the resection of the posterior spinal nerve-roots. A criticism that is perhaps more to the point concerns the very brief mention made of surgical methods of examination. In a volume designed particularly for student purposes, an enumeration and description of bedside methods is certainly of considerable importance.

Where there is any radical difference of opinion amongst surgeons regarding the proper treatment of a given disease, mention is usually made to this effect and the views are briefly enumerated. The author's discussion of such a common disease as appendicitis is excellent and should prove very helpful to the student. He prefers to remove the appendix as soon as the diagnosis is established, rarely waiting for other features to develop.

In the field of gynæcology several important conditions are omitted. No reference is made to such common disorders as carcinoma of the uterus and perineal lacerations. It is manifestly impossible to make a text of this nature cover all the diseases of surgery and the provinces associated with it. Nevertheless, a consideration of the commoner surgical ailments is undoubtedly more valuable to the beginner than a reference to curiosities and laboratory tests.

A commendable feature of the discussion on cranial tumors is the emphasis laid on preventing blindness. With most neurologists the author encourages early operative interference.

The criticism mentioned above, regarding the failure to record certain recent operative therapy, is noted again in the discussion of Pott's disease. Calot's jacket treatment, which is probably the best therapy suggested thus far, receives no mention. Though the new plastic operation of Albee is still in the experimental stage, it seems as though it warrants a reference.

In reviewing the work one feature particularly attracts the attention of the reader—an absence of any references to the current literature. While this holds true for some of our standard text-books, it nevertheless seems inexcusable in a work designed chiefly for the instruction of the growing generation of surgeons. The undeniable benefits accruing from the references included in texts used during undergraduate years makes this an important feature.

While the illustrations are not of the best workmanship they are

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practically all new and, accordingly, are refreshing. The greater number are clear and significant. Only a very few are devoted to the illustration of steps and methods in operative technic.

The style is attractive and the English terse and to the point. The argument is followed throughout with but little difficulty. For students particularly this new volume should prove very useful.

ERNEST G. GREY.

A SYSTEM OF SURGERY. Edited by C. C. CHOYCE, B.Sc., M.D., F.R.C.S. AND J. MARTIN BEATTIE, M.A., M.D., C.M. Volume iii, text 874 pages, illustrations 242. Publishers: Funk, Wagnalls Co., N.Y.

This third volume of Choyce's system of surgery completes the work by considering the following subject matter: cardiovascular, lymphatic, respiratory and muscular systems; neck, ear, nose and throat; bones, joints and deformities, with a general index of the entire three volumes of the system.

In common with the first two volumes the reviewer notes the clear-cut comprehensive style of the text, the more than usual space devoted to surgical pathology as an introduction to each chapter and subject and the useful bibliography that closes the same.

The anatomical, physiological and pathological point of view is so well established that what follows of text becomes a natural surgical sequence and not an isolated statement of fact. A chapter entitled "Lymphatic Invasion of Cancer" and another on the correlation of cerebrospinal physiology and the symptomatology of its surgical diseases illustrate this point of view to the great profit of any reader.

The chapter on bursæ is a monograph: those on the diseases of the osseous system and joints by the editor occupy 234 pages of well-arranged text and well-selected, not overcrowding illustrations.

Those factors in bone anatomy, histology and osteogenesis that have so important a bearing on the proper surgical conception of bone disease have been given notably careful consideration.

As in the first and second volumes, operative technic is dealt with suggestively, leaving space for the study of the basic principles of surgery and avoiding the usual presentation of many discarded and antiquated operative procedures.

Again the reviewer commends this work as a broad general treatise, with a thoroughly scientific point of view, expressed by men well known in their fields of work, and compiled in such a manner as to justify publication and study.

WM. C. WOOLSEY.



## BOOK REVIEWS

ANOCI-ASSOCIATION. By GEORGE W. CRILE, M.D., AND WM. E. LOWER, M.D., Cleveland: W. B. Saunders Co., 1914.

This volume of 250 pages by Crile and Lower will be welcomed by every physician. Part I contains a statement of the kinetic theory of shock and the principle of anoci-association. Part II contains a statement of the application of the kinetic theory to the technic of surgical operations.

The introductory chapter should be read, as it states the several steps which Crile and Lower followed in pursuit of the causes, manifestations and treatment of surgical shock. According to the kinetic theory of shock the exclusion of both traumatic and emotional stimuli will wholly prevent the shock of surgical operations. In this book are grouped the several factors which make for operative safety. The authors have attempted to show the importance of these various factors.

However we may feel regarding the practical application of all the procedures advocated as necessary in order to prevent shock at surgical operations, this book impresses one as a valuable contribution from the laboratory and the clinic to practical surgery. In this monograph keen observers have linked the returns from the experimental laboratory and the hospital clinic and have given to the operating surgeon facts of inestimable value for safer surgery. The chapter upon the technic of administering oxygen anæsthesia is a valuable one. In the appendix of the book are stated the relations of anoci-association to the pre-operative and post-operative care of patients.

I believe that the practical application of anoci-association in a large general hospital service is attended with many difficulties. I believe that in a few selected cases it is of very great value in its completed form. I believe that surgery to-day is greatly indebted to Crile and Lower for the results of this experimental work. Surgery has been made safer because of these researches. The principle of anoci-association has been placed upon a firm basis and this achievement is a contribution to surgery of very great value. The importance of the work of Crile and Lower lies in the fact that they have succeeded in correlating the various factors which enter into the principles of anoci-association. They have grouped together the many factors and have shown the relations of these factors one to the other and to the general principle of anoci-association. Herein lies the great value of this contribution to surgery. The book should be read by every medical man, physician and surgeon alike.

CHARLES SCUDDER.



## CORRESPONDENCE

### ALUM CREAM

#### THE IDEAL RUBBER GLOVE LUBRICANT

FOR at least ten years past the writer has been regularly in the habit of using alum cream, and his various staffs of assistants have done so, too, during this time. It has proven so satisfactory and fulfils so many different functions besides lubrication that surely it deserves to become more widely known.

In appearance its name of cream is sufficiently accurate. Sometimes, however, for a reason to be subsequently explained, it is distinctly pink or purplish. This is without any importance as to its effects, in usage.

Its formula is as follows:

Take:

Sodium Carbonate .....	℥ i
Aluminum Sulphate .....	℥ iv ℥ ii
Tragacanth .....	℥ ii
Ac. Salicylic .....	℥ ii
Glycerine .....	℥ iss
Alcohol .....	℥ vi
Water .....	℥ iv ℥ ii

The compounding is done as follows: Take the sodii carb., alum. sulph., tragacanth, mix; then add the hot water and glycerine and rub well together until a smooth paste results; then add ac. salicylic, dissolved in alcohol. Again triturate well together. Let it stand one hour; then add enough water to make ℥viii.

The aluminum sulph. is not only a well-known antiseptic, but also a powerful astringent. It promptly prevents any sweating within the glove; and if the hands are first thoroughly cleansed mechanically, using this alum cream freely is all that is necessary to accomplish thorough antisepsis within five minutes following.

The ac. salicylic has three functions in the cream: (1) It is one of our best-known antiseptics; (2) it counteracts the tanning and hardening tendency of the alum salt; as we all know, ac. salicylic is our best-known softening agent upon the skin; and (3) through its presence in the cream it becomes, so far as known, *our only tell-tale lubricant*. If a glove is punctured even to the extent of a drop of blood admitted from without or escaping from a punctured finger-tip within, and thus coming into contact with the lubricant, at once the fact is known because an

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almost inky blackness appears at this spot; and we are thus aware that the glove must be changed. The explanation is that salicylic acid strikes with the iron which is such a prominent ingredient of the blood a deep purple, the iron salicylate in some lights looking almost black.

Now, why is the "cream" sometimes—quite often—pink or purplish in color? The answer is that hardly a specimen of either alum. sulph. or of sodium carb. is free from at least a trace of iron. Iron, in some cases as a soluble, in others an insoluble impurity, is the most widely prevalent chemical known; and traces of it are almost invariably found in all heavy chemicals. The best-known re-agent for the detection of this trace is acid salicylic or a salicylate—the addition of which will produce immediately a color varying from the faintest pink tinge to a deep purple, according to the amount of iron present.

A few further points I would like to mention: It is noticeable, after the longest operation, if the gloves are proper in point of size and do not constrict the fingers, that if anything the sensibility seems rather increased than lessened. Of course the various dry lubricants must have the opposite tendency. Again, the reason why so large a proportionate amount of washing soda is used is that with less there is a degree of acidity which, though trifling, may annoy some skins, conceivably. It is surprising, unless one has tested the point, how very acid is alum. sulph.

Finally, a point by no means to be ignored, is the query—Is this lubricant an irritant to any serious degree, if brought in contact accidentally with the wound surface? The reply, based upon experiment, is in the negative. Perhaps as striking an evidence of this as could be adduced is the one which follows:

During my active professorship in the Polyclinic Medical School, upon one occasion I was asked to operate upon a case of acute appendicitis. As it was not my clinic day I borrowed instruments and assistants and set to work. With the wound fully made, but as yet not penetrating the peritoneum, an assistant allowed a four-hooked, sharp-pointed retractor to slip, and it tore one of my gloves from Dan to Beersheba. At once the wound was, for most of its extent, smeared with the alum cream from within that torn glove! As the assistants were removing it as well as they could by flushing with sterile warm water, I called Prof. Wyeth's attention to the accident, asking him to bear witness as to the ultimate outcome. The stain would by no means all come away. The very dark salicylate of iron was fixed in the blood of the exposed tissues. However, the case resulted in healing under primary union, quite as if nothing untoward had happened.

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To turn for a few moments to the better known methods of lubrication of gloves—I think it safe to say that in New York in by far a majority of cases either baked starch or baked talcum powder is the substance employed. Either of these is, however, an obvious tactical error; for both, being insoluble in water or in blood-serum, in event of a torn glove would be like so much sterilized brick-dust deposited in the tissues, a mechanical irritant. If one must use a dry powder and cannot see the sundry advantages of alum cream, at least by employing baked boric acid, itself a mild antiseptic, a smooth lubricant and soluble in the bloodstream, he would thereby have a logical reason to give—in contrast with those who prefer talcum or starch.

New York City.

ROBERT H. M. DAWBARN, M.D.

### THE OBLIQUE EXTENSOR RADIAL RIDGE

BEGINNING near the posterior-external border of the radius, just above its expansion, running upward and inward across its posterior surface just below the tendon of the extensor brevis pollicis, is an oblique ridge which attaches the sheath of the thumb extensors.

In skeletons whose muscular development was scant it is often imperceptible, though it shows faintly in well-developed skeletons. In the vast majority of living subjects it is clearly palpable.

While palpating this region for suspected fracture of the radius one may easily mistake this ridge for the posterior, upper edge of the lower fragment of an obliquely fractured radius, and its importance in this connection seems to warrant calling the attention of fracture surgeons to it.

Syracuse, N. Y.

HERBERT GIFFORD, M.D.

### REPORT OF A CASE OF PURE MYXOMA OF THE BREAST

Patient: Mrs. E. B., aged thirty-three, mother of three children, youngest eight years of age. Deliveries and lactations normal.

Complaint: Tumor in left breast; duration 2 years. No pain or discharge from the nipple. No lumps in other breast.

S. P.: Examination reveals small tumor about 5 cm. in diameter in outer half of left breast. It is freely movable under the skin. It is not tender on palpation. Except for this tumor, this breast and the other are normal. There are no palpable glands in either axilla.

Operation: Removal of tumor under local anæsthesia, April 12, 1912. The wound healed without complication.

Result (July, 1914): Patient well; no other lumps in the breast.

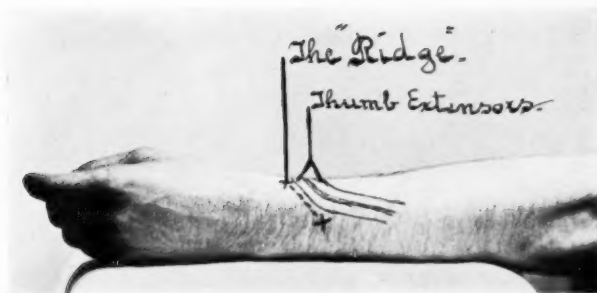


FIG. 1.—The oblique extensor radial ridge.



FIG. 1.—Gross appearance of myxoma of breast, after removal and hardening in formalin.

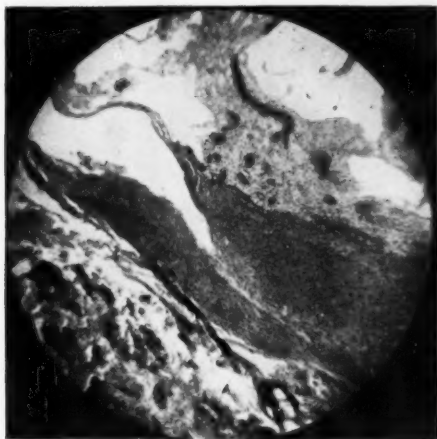


FIG. 2.—Photomicrograph of section through tumor, low power. From below upward observe normal breast tissue, fibrous cellular tissue of tumor, of capsule, and this tissue of the tumor proper.

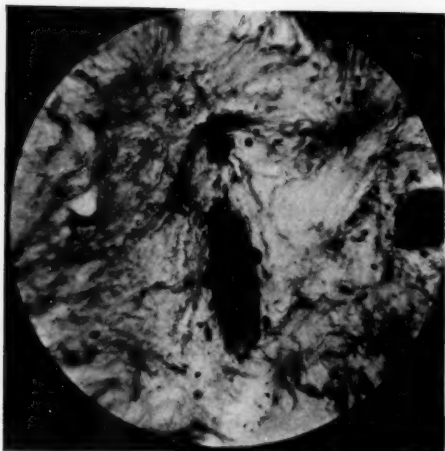


FIG. 3.—Myxoma of breast. High-power photomicrograph: myxomatous tissue about two blood-vessels.

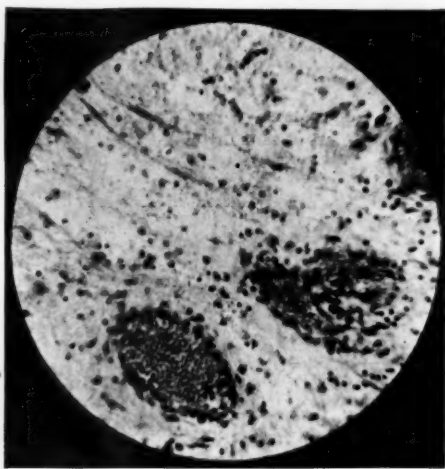


FIG. 4.—High-power photomicrograph: tumor tissue and blood-vessels.



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She complains of a stinging sensation in the left breast when she gets warm from exertion. There is no pain in the scar. The tumor was examined by Dr. Bloodgood, whose report, with photographs, is as follows:

Gross pathology: Fig. 1, photograph of formalin specimen. This shows an encapsulated tumor with a narrow zone of normal breast tissue above. In the photograph one can see the breast tissue opaque white, the capsule of the tumor, and the tumor.

Microscopic note: Fig. 2, photomicrograph, low power. From below upward this section shows the breast tissue, the fibrous cellular tissue of the capsule of the tumor, and the tumor. Fig. 3, high-power photomicrograph. Myxomatous tumor tissue about two blood-vessels. In this portion of the tumor there are but a few scattered staining cells. Fig. 4, high-power photomicrograph. Tumor tissue and blood-vessels more cellular.

Throughout the tumor I was unable to find any evidence of the parenchyma of the breast. This is the first case of pure myxoma among 1400 breast tumors.

It is a pleasure to acknowledge the assistance of Dr. Bloodgood in reporting this case. The photographs are by Mr. Schapiro of his laboratory.

Greenville, S. C.

GEORGE T. TYLER, M.D.

## CALCIFIED FIBRO-ADENOMA OF BREAST

THE following case history is of interest chiefly because of its rarity. It seems unique, as I have not been able to find its parallel in the literature.

Mrs. J. D. McF.; aged forty; married. Robust woman, weighing 189 pounds. Family history, ideal. Has had five children, youngest two years old. Confinements and lactation normal. No previous illnesses. At the age of fifteen years, while breasts were developing, sustained an injury to right breast by being stepped upon by her brother in play. She experienced much pain at that time, and later consulted a physician because of induration and tumefaction of the breast. The induration never entirely disappeared, though until recently it has attracted no special attention. For the past three months the breast has enlarged perceptibly, and has become sensitive to pressure.

Physical examination shows both breasts to be a little over medium size, and well maintained. The right breast is perceptibly enlarged and uniformly rounded. The skin is normal in appearance and the nipple is unchanged. The mass alluded to lies in the upper inner segment. It is very hard and irregular in outline. Slight pressure elicits acute

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tenderness. The overlying skin, while not attached, is not as freely movable as other areas.

The breast, generally, presents a porky consistency, but it is not attached to the underlying muscle. No lymph-nodes are present in axilla or elsewhere. The very notable hardness and tenderness of the tumor prompted removal of the entire gland, which was done on August 28, 1913.

On incising the gland, there was disclosed a gray-colored mass, about the size of an English walnut. This was composed of a thick capsule, distended by a well-formed, irregular concretion, about the size of an ordinary olive. The mass within the capsule was unyielding and its general appearance was that of a calculus. Convalescence was brief and the patient remains well up to the present time.

Dr. Ophuls, of the Pathological Laboratory of Stanford University, reports as to the pathological findings upon examination of this mass:

"In mammary tissue is a hard, calcified, well-circumscribed tumor, 3 by 5 centimetres in diameter. Sections show that tumor consists of dense fibrous tissue which is entirely necrotic. Large irregular calcified areas. In the fibrous tissue were found narrow open spaces without epithelial lining. The breast tissue shows marked cellular infiltration, hyperplasia of the glands, some of which are filled with fatty material. Nothing suggestive of malignancy. Diagnosis: Fibro-adenoma of breast (calcified chronic mastitis)."

The ultimate causative factor, in this case, is a matter of some interest. Recognizing the fact that a tumor was present from the date of injury, which never entirely disappeared, it seems probable that the early lesion can be identified as a hæmatoma, and later as a hemorrhagic cyst, which, finally, underwent calcification.

Its immediate importance is found in the fact that a very definite irritation, of recent date, was manifest, suggesting the possibility of malignancy at a later period.

San Francisco, Cal.

THOMAS W. HUNTINGTON.

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